SCIENCE ABSTRACTS.

Section A.—PHYSICS.

DECEMBER 1906.

GENERAL PHYSICS.

1982. *Experiment to Illustrate Uniform Acceleration.* **A. W. Duff.** (Science, 24. p. 538, Oct. 26, 1906.)—A groove of circular cross-section is cut in a plank about 5 ft. long, the width of the groove being about 4 in., and its radius of curvature 4 in. The groove is painted black, well polished, and then sprinkled with lycopodium dust. The plank may be fixed at a given inclination, and a steel ball 1¼ in. diam. caused to roll down it, the ball being given a lateral motion so that it oscillates from side to side of the groove as it descends. The time of lateral oscillation of the ball is constant and may be predetermined, and since it leaves a well-defined track on account of the lycopodium powder, the acceleration may easily be shown to be $(5/7)g \sin \theta$, where θ is the inclination of the plank. If the plank itself rest on an inclined plane the coefficient of kinetic friction between the plank and the plane may be determined by obtaining two records: one when the plank is fixed and the other when it slides down the plane. S. G. S.

1983. *Elastic After-effect in Crystalline Quartz.* **A. Joffé.** (Ann. d. Physik, 20. 5. pp. 919–930, Sept. 14, 1906. Extract from Dissertation, München.)—The elastic after-effect in quartz was investigated by two different methods: (1) An indirect, through the measurement of the piezo-electricity produced by the after-effect, in this Curie's piezo-electric quartz was employed; (2) by direct observation of the deformation after-effect following the bending of a specimen of quartz. The results obtained are as follows: 1. The elastic bending after-effect in crystalline quartz is not demonstrable by the means employed. In quartz plates which were deformed without electric excitement, the after-effect within intervals of time from 1 sec. to 1 hour after a previous deformation lasting 80 hours is smaller than 0·00007 of the indicated bending, whilst it attains more than 2 per cent. of the deformation in ordinary glass. 2. The deformation after-effect occurring only with piezo-electricity is a secondary electric deformation which depends on disappearance of the piezo-electricity. 3. The progress of this after-effect is hastened by radiation with radium, Röntgen rays, and ultra-violet light, and by raising of the temperature. This influence is greater the longer the duration of the radiation before the observation of the after-effect. Also, after the cessation of the radiation the influence on the after-effect remains, and disappears very slowly with lapse of time. 4. After the disappearance of this influence the sensitiveness towards new radiation is lessened. The sensitiveness does not return, neither in course of time of itself, nor through heating the quartz to 350°. 5. The influence of radiation and raising of temperature depends on an increase of the electric conductivity; it is greater in the direction of the principal axis than at right angles thereto. 6. In the case of various kinds of glass investigated, that named 0102 of C. Zeiss exhibits an especially small after-effect which is sixteen times smaller than in the case of a plate of ordinary glass. 7. The *elastic* after-effect is not sensibly influenced by radiation of the above-mentioned kinds. J. J. S.

1984. *Equilibrium of Cyclic Elastic Body.* **V. Volterra.** (N. Cimento, 11. pp. 338–347, May and June, 1906.)—The hollow cylinder is treated as previously [see Abstract No. 1680 (1906)], and distortions of the first, third, fourth, and fifth order are considered, in the first place theoretically, and then the models are constructed as in the earlier papers. In the case of the fourth-order deformation the slot is wedge-shaped, the planes being equally inclined to the axis of the cylinder; in the first-order deformation a cut is made parallel to the axis, and one face of the cut caused to slide over the other in a direction perpendicular to the axis; in the third-order deformation the same cut is made as in the last case, but the sliding takes place in a direction parallel to the axis; and finally, in the case of the sixth-order deformation the faces of the cut are caused to rotate with respect to each other about their common normal. S. G. S.

1985. *Factor of Safety of Winding Ropes.* **J. A. Vaughan.** (Engineer, 102. pp. 189–190, Aug. 24, and pp. 212–213, Aug. 31, 1906. Abridgement of paper read before the S. African Assoc. of Engineers, March 30, 1904.)—In connection with the consideration of the factor of safety to be used in designing winding ropes, the author analyses several specific problems. When a load W_s is being lowered with uniform velocity v by a weightless rope of sectional area k, and Young's modulus E, and the motion is suddenly stopped when a portion of unstretched length L has been paid out, the maximum stress at the upper cross-section is $v\sqrt{(W_sE/kLg)}$ + the static stress W_s/k. In the case of a uniform rope of weight W_r, not carrying any other load, the dynamic stress is $v\sqrt{(W_rE/kLg)}$. For a heavy rope carrying W_s it is shown that for lengths of rope weighing less than 0·35 of the load carried, the max. kinetic stress at the upper cross-section, due to a sudden stop in lowering, increases rapidly as the length is shortened, while for a length equal in weight to, or greater than, 0·35 of the load, the kinetic stress is $3v\sqrt{(Ew/g)}$. The values of stress and factor of safety for various lengths are shown diagrammatically, and the author carried out some rough confirmatory experiments. Several special cases are also discussed. [See Abstract No. 48 (1906).] F. R.

1986. *Resistance of Tubes to Collapse.* **A. P. Carman and M. L. Carr.** (University of Illinois, Bull. 3. No. 5. pp. 1–26, June, 1906.)—The authors' experiments, on tubes up to 10 ft. long, show that the length of the portion of a long tube affected by the collapse is generally not greater than 12 diams. The collapsing pressure varies inversely as the length only for very short tubes—usually those less than from 4 to 6 diams. long. For thin tubes (t/d below about 0·025), $P = 25{,}150{,}000\,(t/d)^3$ for brass, and $P = 50{,}200{,}000\,(t/d)^3$ for cold-drawn seamless steel, where P is the collapsing pressure and t and d

the thickness and outside diam. respectively, in inch-lb. units. When t/d is greater than about 0·03, for brass, $P = 93,365\ t/d - 2,474$; for cold-drawn seamless steel, $P = 95,520\ t/d - 2090$; for lap-welded steel $P = 83,270\ t/d - 1025$. Useful approximate formulæ are: For cold-drawn seamless steel, $P = 1,000,000\ (t/d)^2$, and for lap-welded steel $P = 1,250,000\ (t/d)^2$, when t/d is less than 0·06. [See also Abstract No. 239 (1906).] F. R.

1987. *Heat Treatment of Reinforced Concrete Columns.* **H. B. MacFarland.** (Eng. Record, 54. pp. 329–330, Sept. 22, 1906.)—Describes tests showing that reinforced concrete columns were practically valueless after 3 hours' submission to fire at 1,500° to 1,600° F., whether followed or not by water quenching, unless the column had first been fireproofed with solid porous tile set in cement, with metal fabric in the joints. F. R.

1988. *Relation between some Physical Properties of Bitumens and Oils.* **A. W. Dow.** (Eng. Record, 54. pp. 185–186, Aug. 18, 1906. Paper read before the Amer. Soc. for Testing Materials, June 21, 1906.)—The more susceptible a bitumen is to change of temperature, as shown by the amount of penetration of a needle under a given load in a given time, the more ductile, and at the same time the more brittle under shock at 0°, is the material. This law is not absolutely complied with by all hyperviscous liquids, but the approximation is sufficient to be of use. It was also found that in the case of heavy oils the change of viscosity with temperature followed a similar law for each oil, the viscosity being indicated by the Doolittle viscometer and also by a viscometer of the author's design, in which a loosely-fitting plunger gradually descends under a known weight, in a cylinder. The theory is advanced that the more complete the solution in one another of the compounds composing a bitumen, the more susceptible to the influence of temperature and the more ductile will the material be. It is argued that the viscosity test is rather an indication of surface tension than of viscosity. The view is supported by some observations of the nature of the flow near the surface in the neighbourhood of the needle used in the penetration tests. F. R.

1989. *Flow of Air under Low Pressure through Circular Holes in Thin Plates.* **R. J. Durley.** (Amer. Soc. Mech. Engin., Trans. 27. pp. 193–227; Discussion, pp. 227–231, 1906. Read Dec., 1905.)—Experiments were made on the discharge of air into the atmosphere through orifices of not greater diameter than 6 in. and at heads not exceeding 6 in. of water. The conclusions arrived at are that the coefficient of discharge (1) for small orifices increases as the head increases, but at a less rate the larger the orifice, so as to be practically constant for a 2-in. orifice; (2) for orifices larger than 2 in. decreases as the head increases, and at a greater rate the larger the orifice; (3) decreases as the orifice increases, and at a greater rate the higher the head; (4) does not vary appreciably with temperature, at least between 40° and 100° F.; (5) for heads under 6 in. is not appreciably altered by the size of the containing box if the area of the box is at least 20 times that of the orifice. R. E. B.

1990. *Photographs of Thin Liquid Films.* **H. Stansfield.** (Chem. News, 94. p. 89, Aug. 24, 1906. Abstract of paper read before the Brit. Assoc. at York.)—Photographs were exhibited showing the thinning process of plane vertical soap films. At first the thinning occurs continuously, but when the thickness is reduced to about 100 $\mu\mu$ there is a change, and the thinning proceeds by a series of abrupt steps. J. J. S.

1991. *Structure of Hailstones.* **D. S. Landis.** (Monthly Weather Rev. 34. pp. 277–278, June, 1906.)—Hail fell for 50 minutes at Fort Worth, Texas, during the evening of June 20. The stones were mostly oblate spheroids, diameters 2¼ and 1¾ in., showing 3, 5, 7, or 9 layers, all of crystal ice, except the third and the layer next to the surface, these being granular or snowlike. The 9-layer stones came in a direction almost opposite to the wind course. Some of the granular layers and also the centres gave off air-bubbles, the centres of the 7- and 9-layer stones did not. The nature of the centre nucleus and of the layers seems to depend upon the meteorological conditions prevailing at the altitude at which the hail was formed. **W. Smith** (ibid. p. 277) reports on a fall of hail at Mifflintown, Pa., on July 28. Other occurrences are mentioned. H. B.

1992. *Mountain Building and Abyssal Igneous Injection.* **R. A. Daly.** (Amer. Journ. Sci. 22. pp. 195–216, Sept., 1906.)—Premising the hypothesis of a cooling earth superficially composed of a relatively thin crust overlying a fluid gabbroid substratum of unknown thickness, this substratum will be so compressed by the weight of the crust as to be probably able to float the crust. Through differential cooling contraction the development of a level of zero strain will occur in the crust not far from the bottom surface of the shell of rock fracture, and there will be an accumulation of pressure in the shell of compression and a simultaneous accumulation of cooling cracks and of some of the powerful tension unrelieved in the shell below the level of zero strain; also a steady or recurrent dislocation of the shell of tension permitting of the forcible injection of the fluid substratum to which even the viscous layer of the shell acts as a relatively solid mass at the moment of dislocation. The author concludes that the abyssal injection will then involve condensation of the matter in the shell of tension. So long as the body remains fluid, the stretching of this shell due to continued cooling of the earth is accomplished by creep of matter in the same directions. This lateral creep induces a down-warp of the earth's surface immediately overlying the zone of condensation. The resulting geosynclinal may be the seat of prolonged sedimentation. If so, the weight of the sediment itself tends to increase the lateral creep in the sheet of tension and the down-warp slowly deepens. Thus the shell of compression being already weakened at the angles of down-warp, is further weakened by the sedimentary stratum, which causes a softening of its basement through a rising of the isogeotherms. When the filling of the geosynclinal has sufficiently thickened, the shell of compression, owing to its secular accumulation of stresses, begins to collapse. Mountainous forms and structures result. The complete shearing apart of the shells of compression and tension during the orogenic revolution releases the tensions still unrelieved in the underlying shell. Abyssal injection on a large scale is thus initiated or continued in the shell of tension. The regional warpings of the earth's crust may be partly at least referred to the varying strengths of abyssal injections from a fluid substratum. The location and alignment of mountain ranges, the location and elongation of geosynclinals, the final development of igneous batholiths and satellitic injections, are all interdependent and related to special zones of powerful abyssal injections from the substratum. These zones are located by cosmical stresses affecting the earth along special azimuthal lines. C. P. B.

1993. *Movement of the Earth's Pole.* **M. Brillouin.** (Comptes Rendus, 143. pp. 437–438, Sept. 17, 1906.)—The curves showing the projection of the motion of the earth's pole on the equatorial plane, published by Albrecht, are analysed by the author from a purely physical standpoint. The curves show a distinctly triangular form; the radius vector has a principal component, slowly variable, and a periodic component of about one-third year. As the curves were constructed with a time scale of one-tenth year, however, it may be that the real period of the second component may be a lunar month. Other components of the motion appear to be due to internal causes, and an examination of their times of occurrence shows suggestive coincidences with the epochs of great earthquake shocks. C. P. B.

1994. *Nebulæ and the Constitution of the Milky Way.* **L. Courvoisier.** (Astron. Nachr. 170. pp. 325–340, 1906.)—Referring to Wolf's discovery of star-free regions bordering large nebulæ in the Milky Way, the author points out that he has observed that the lines joining such regions with the nebulæ have a common direction in space. Further, these lines of junction are all practically parallel to the plane of the Milky Way, and the star-free regions are directed towards the constellation of the Swan. Easton's hypothesis as to the spiral shape of the Milky Way is hence in conformity with the observations. The subject is further discussed. L. H. W.

1995. *Physical Constitution of the Corona.* **H. H. Turner.** (Manchester Lit. and Phil. Soc., Mem. 50. No. 7. pp. 1–32, Aug. 27, 1906. Wilde Lecture.) —After a short description of the general phenomena of a total solar eclipse, the method adopted by the author for obtaining quantitative measures of the brightness of the corona is described, with discussion of recent theories in connection. The recent photographs obtained by Hansky showing the decided drift of granules on the solar surface with velocities of from 10–20 miles per sec. appear to support the idea that the corona is due to particles driven out from the sun's surface, as from various calculations this is regarded as the velocity shown by the corona particles. The observed falling-off in light of the corona must be referred to the fact that light-pressure nearly, but not quite, balances gravity for the particles forming the corona; that the difference accordingly varies in magnitude; that there are many more particles for which the difference is large than for which it is small; and that particles ejected vertically from the sun's surface with velocities similar to those observed in the granules might then distribute themselves according to the observed law. This discussion only applies to that part of the corona showing strong polarisation. [See Abstract No. 488 (1906).] C. P. B.

1996. *Summary of Observations of Total Eclipse of the Sun.* **A. Riccò.** (Accad. Lincei, Atti, 15. pp. 343–352, Sept. 16, 1906. Mem. dell' Soc. degli Spettroscopisti Italiani, 35. 9. See also Nature, 75. p. 16, Nov. 1, 1906.)— The paper is a short account of telescopic and spectroscopic observations made by the author at Alcalà de Chivert, Spain, on Aug. 30, 1905. The form of spectroscopic camera employed is described. The most important of the spectra observed is reproduced: it is the spectrum taken at the instant of the "flash," and consists of bright lines due to the inverting layer, and shows several large protuberances. In part of the field the spectrum is continuous, owing to the light reaching the earth from the lower layers of the chromosphere having passed through the larger gaps between the lunar mountains. The paper is not of a nature to be satisfactorily abstracted, but the observations are grouped under the following heads: Photographs; Comparison of the monochromatic images of the protuberances; White protuberances; Height of the inverting layer of the chromosphere; The corona; Monochromatic images of the corona; Line spectra of the corona. S. G. S.

1997. *Colours and Spectra of Prominences.* **Riccò.** (Comptes Rendus, 143, pp. 441–444, Sept. 24, 1906.)—Details of various colours seen in the solar prominences, with a possible explanation of the interesting *while* prominences. Reproduction of photographs of the spectra obtained during the total solar eclipse of Aug. 30, 1905, show the continuous spectrum of certain prominences distinctly. Comparisons are made of the heights of prominences seen visually and measured from the photographs, the latter being generally the greater. [See preceding Abstract and Nos. 70, 855, 1027, 1549 (1906).] C. P. B.

1998. *Researches on the Telluric Lines.* **M. Štefánik.** (Comptes Rendus, 143, pp. 573–575, Oct. 22, 1906.)—After the author succeeded, by his screen method [Abstract No. 1375 (1906)], in rendering a great portion of the infrared spectrum visible, he studied this region from the point of view of telluric absorption. The researches, begun at Meudon, were continued at Chamounix (1,060 m.), Grands-Mulets (3,050 m.), and finally at the summit of Mont Blanc (4,810 m.). The spectroscope employed was specially designed to avoid loss of light as far as possible. A concave mirror projects the image upon the slit behind which a small plane mirror is placed to reflect the pencil to a concave collimating mirror; the parallel pencil then traverses a hollow prism (filled with carbon disulphide) of 28° closed by a plane parallel plate, and silvered internally. The collimating mirror receives the pencil for the second time, and forms a spectrum at its focus. This spectrum, which is extremely bright, can either be viewed directly or, if higher dispersion is required, through a small direct-vision spectroscope with a plane metal grating. In front of the first slit is placed a special screen consisting of a hollow vessel, with walls made of plane parallel sheets of fluorine, and filled with an absorbing medium. At Grands-Mulets, when the spectrum region from B to about 1μ was observed, the sun being 15° above the horizon, B, *a*, A already showed effects due to the atmosphere. As the sun descended, parts of the *a* group were unequally reinforced, faint bands appeared between *a* and A, and the groups Z, X, and Π grew stronger in succession, finally melting into bands; A tended to run into *a* and then into Z, while B showed no sensible change. On one occasion a special faint band, seen by the author once before in Spain near the sea, appeared between A and Z. The increase of intensity in the Z and π groups was so great that their telluric nature was evident. Zenithal observations gave the following results: B and A fainter than at the horizon (especially the head of A), *a* nearly invisible, between *a* and A no trace of absorption, of Z only two lines visible, probably λ8160 and 8220; also only a few lines of the X group were seen, and in the less refrangible spectrum no well-defined lines could be found. A great number of photographs were secured at Mont Blanc, with the sun near the zenith and near the horizon. [See also next Abstract.] A. E.

1999. *Telluric Lines in Infra-red Spectrum.* **M. Štefánik.** (Comptes Rendus, 143, pp. 734–736, Nov. 12, 1906.)—The author has detected various groups of telluric lines in the solar spectrum up to λ10000. He attributes to water vapour groups of lines at λ7950, λ8200, λ9150, and probably λ9000. [See also preceding Abstract.] C. P. B.

2000. *Chromospheric and Sun-spot Spectra.* **W. M. Mitchell.** (Astrophys. Journ. 24. pp. 78–94, Sept., 1906.)—Comparing old and recent observations of the affected lines in sun-spot spectra, it was found that the selection of *widened* lines in the two periods was so similar that it would not be necessary to publish the list again. When considering the reversed and weakened lines, however, this is not the case, many new ones of both classes being detected. A list is given of the lines seen reversed or weakened in spots, or bright in the chromosphere, from λ4876·59 to 6888·83, showing their origins and intensities. In endeavouring to connect up these phenomena with facts observed in the laboratory, it is pointed out that the presence of hydrogen in the chromosphere may cause certain lines to be suppressed, at least to such an extent that they may become invisible against the background of sky spectrum. This would agree with the facts recorded by Fowler, that the high-level lines are *enhanced* lines, since it is probable that high in the chromosphere the proportion of hydrogen is greatest, while lower in the reversing layer other lines besides those found in the spark spectrum make their appearance. The emission-coefficient of these high-level lines being greater than that of the lines caused by lower-level gases, the absorption of the lines would not be so great, hence across the dark umbra of the spot the line would have an enfeebled or weakened appearance. C. P. B.

2001. *Cause of the Characteristic Phenomena of Sun-spot Spectra.* **G. E. Hale, W. S. Adams,** and **H. G. Gale.** (Astrophys. Journ. 24. pp. 185–213, Oct., 1906. Contribution from the Solar Observatory, No. 11. Abstract in Nature, 75. pp. 113–114, Nov. 29, 1906.)—The three chief characteristic features of sun-spot spectra are (*a*) certain lines in the spectrum of a given element are strengthened, while others are weakened, the remainder being unaffected; (*b*) all the strengthened lines appear to be in the visible region of the spectrum, and none in the ultra-violet; (*c*) the relatively great intensity of the continuous background of the spot spectrum in the less refrangible region. Now from laboratory work on spectra we know that in passing from high to low temperatures certain lines are strengthened, some are unaffected, and others are reduced in intensity; also that such reduction of temperature is accompanied by an increase in the relative intensity of the less refrangible lines, and a shift of the maximum of a continuous spectrum towards the red. The general resemblance between these two classes of phenomena suggested that the difference in spectrum between sun-spots and the photospheric disc might be due to variation of temperature merely. For the investigation photographs of the sun-spot spectrum have been obtained with the Snow Littrow spectrograph of 18·5 ft. focus, showing an immense number of affected lines. These plates, which cover the region D to H_β, and others covering the whole spectrum have also been examined. The laboratory spectra have been obtained by volatilising the various elements in electric arcs of varying powers, from 30 to 2 amps., and in the electric spark. As the work progressed a distinct correspondence was noticed between lines that are *enhanced* in the spark and those that are *weakened* in sun-spots. Lengthy tables are given of the results of these comparisons, showing, for the elements Ti, V, Fe, Cr, Mn, between the limits λ4060·42 to λ5800, the degrees of enhancement or diminished intensity of the lines. In discussing the great amount of information available, it is at once evident that very few lines are found which are certainly strengthened or weakened in the low-current arc that are not either spot lines or lines enhanced in the spark. Taking the elements Ti, Cr, Fe, V, Mn, there is a complete agreement of most of the representative lines which are "*spot*" lines and "*weak arc*" lines. Turning to the lines which are decreased in intensity in the weak arc, practically all these are seen to be enhanced spark lines and also lines which are weakened in sun-spot spectra. It has already been noticed by various workers that the sun-spot special lines are characteristic of the spectra of the red stars, which have been regarded as being of lower temperature than the solar stars. All these criteria thus indicate that the differences between the photospheric Fraunhofer spectrum and the sun-spot spectrum may be ascribed to differences of temperature only. [See Abstracts Nos. 90, 490, 1538 (1906).] C. P. B.

2002. *Calorific Emission of the Sun.* **C. Féry** and **G. Millochau.** (Comptes Rendus, 143. pp. 505–507, Oct. 8; 570–572, Oct. 22, and pp. 731–734, Nov. 12, 1906.)—Using the pyrometric telescope invented by Féry [Abstract No. 1700 (1902)], the authors are able to determine the radiation from any particular portion of the solar surface. The instrument being provided with a silvered mirror, 103 mm. aperture and 800 mm. focus, has at its principal focus a small thermo-electric couple in place of the usual cross-wires. The mirror is protected by a metallic diaphragm with adjustable apertures for regulating the amount of radiation received. Observations are made at four stations at various altitudes, so as to eliminate as far as possible the disturbing effects of the terrestrial atmosphere. To illustrate the effect of altitude, they found the values of the solar temperature at—

Meudon ...... 150 m. altitude, to be 4,820° absolute.
Chamounix 1,030 „ „ „ 5,140 „
Mont Blanc 4,810 „ „ „ 5,560 „

All these measures were made when the sun was at its highest elevation on the meridian. When the complete series taken throughout the day are examined, the absolute temperature varies from 5,500° at 8 a.m., to 5,540° at noon, and 5,140° at 6 p.m. Evaluating the coefficient of atmospheric absorption, the temperature, if no atmosphere existed, would be about 5,620° absolute. The determinations agree well with the values given by Wilson. In the third part examples are given of determinations on various parts of the solar disc. The values found for the solar temperature vary from 5,888° to 5,963° abs. C. P. B.

REFERENCES.

2003. *The Dyne.* **H. C. Barker.** (Science, 24. p. 341, Sept. 14, 1906.)—Points out that the dyne is not correctly defined as the force which, acting on a gramme mass, will produce a unit of acceleration *in one unit of time:* the words in italics should be left out, as the dyne will produce this effect whatever be the time during which it acts upon the gramme mass. A. D.

2004. *Hollow Sphere and Cylinder under Fluid Pressure.* **A. Leon.** (Akad. Wiss. Wien, Sitz. Ber. 115. 2a. pp. 309–336, April, 1906.)—The problems of the elastic equilibrium of the hollow sphere and hollow cylinder subjected to internal and external pressure, are treated, taking into account terms in the stress which are due to those of strain of the second order. The author follows J. Finger in his treatment, and assumes the medium is isotropic before the deformation takes place, and that for the internal forces a potential exists. S. G. S.

2005. *Work Stored in Trochoidal Waves.* **E. Bertin.** (Comptes Rendus, 143. pp. 565–566, Oct. 22, 1906.)—A short note in which the energy-changes and path of the molecules are followed in the case of deep-sea waves, and in the case of two trains of equal waves travelling in opposite directions and giving rise to stationary waves. S. G. S.

2006. *Division Errors of Meridian Circle.* **Lœwy.** (Comptes Rendus, 143. pp. 529–535, Oct. 15; 621–627, Oct. 29; 719–726, Nov. 12, and pp. 857–863, Dec. 3, 1906.)—Announcement and preliminary description of a new method of rigorously determining the errors of each division on instrumental circles of high precision. Details and formulæ of reduction are given in the later papers. C. P. B.

2007. *Waterspout near Tarrytown, N.Y., July* 16, 1904. **M. L. Bacon.** (Monthly Weather Rev. 34. pp. 272–273, June, 1906.)—A waterspout formed over the Hudson River, which is about 2½ miles in width at the place, and disappeared after 10 min., travelling down the river about 1 mile. The river water is said to have risen up to the clouds. The late author took photographs which, however, show little more than the advance of a dark, thick line resembling a dark lightning-flash. H. B.

2008. *Thermodynamics of the Atmosphere.* IV. *Numerical Computations in the Vertical Ordinate.* **F. H. Bigelow.** (Monthly Weather Rev. 34. pp. 265–271, June, 1906.)—The author supplements his theory of the formation of cyclones and anti-cyclones advanced in his International Cloud Report of 1898, in the light of the recent observations; the paper is largely tabular, and a continuation of the work referred to in Abstract No. 1670 (1906). H. B.

2009. *Observations made during Balloon Ascents.* **J. Westman.** (Ark. för Mat. Astron. och Fysisk, Stockholm, 2. 3–4. No. 26, pp. 1–23, April 26, 1906. In German.)—Meteorological observations made during six ascents of the Swedish Aeronautical Society, 1902–1905.

2010. *Influence of the Earth's Rotation on Ocean Currents.* **V. W. Ekman.** (Ark. för Mat. Astron. och Fysisk, Stockholm, 2. 1–2. No. 11. pp. 1–52, Sept. 25, 1905. In German.)

2011. *Valparaiso Earthquake of Aug.* 16, 1906, *recorded at Paris.* **G. Bigourdan.** (Comptes Rendus, 143. pp. 354–356, Aug. 20, and pp. 369–370, Aug. 27, 1906.)—Two Milne pendulums, 1 m. long, have been put up at the Paris Observatory, pointing the one north, the other east; their natural period of oscillation is 7 sec. On the drum 1 min. corresponds to 4 mm. The records of the Valparaiso earthquake did not begin before 12h. 45m. in the night of Aug. 16–17. H. B.

2012. *Weather Forecasting from Synoptic Charts.* **A. J. Henry.** (Frank. Inst., Journ. 162. pp. 297–316, Oct., 1906.)

2013. *Sun-spot Lines in the Spectrum of Arcturus.* **W. S. Adams.** (Astrophys. Journ. 24. pp. 69–77, Sept., 1906. Contribution from the Solar Observatory, No. 12.)

2014. *Spectroscopic Laboratory of the Solar Observatory.* **G. E. Hale.** (Astrophys. Journ. 24. pp. 61–68, Sept., 1906. Contribution from the Solar Observatory, No. 10.)—The equipment is briefly described.

2015. *Total Lunar Eclipse, Aug.* 4, 1906. **G. Le Cadet.** (Comptes Rendus, 143. pp. 509–511, Oct. 8, 1906.)—Details of the total lunar eclipse as observed at Phu-Lien (Indo-China). C. P. B.

LIGHT.

2016. *New 100-inch Mirror for Mt. Wilson Solar Observatory.* **G. E. Hale.** (Astrophys. Journ. 24. pp. 214–218, Oct., 1906.)—The necessary funds having been provided by J. D. Hooker, of Los Angeles, the author is able to announce that a mirror of 100-in. aperture is to be made, with a focal length about 0 ft. As the instrument is to be primarily a "night telescope," precautions will be taken to screen off all heat during the daytime, in the hope of obviating disturbances due to variations of temperature. It is expected that the making of the disc, and the grinding, polishing, &c., will occupy about 4 years. C. P. B.

2017. *Astronomical Refraction.* **C. J. Merfield.** (Roy. Soc. N.S. Wales, Journ. and Proc. 39. pp. 76–92, 1905.)—For some years past the meridian circle at Sydney Observatory has been in constant use for observations of transits and zenith distances of certain stars, and as a preliminary to the star catalogue which will be issued, the present paper is given as an investigation into one of the important systematic corrections. The stars employed in the determination were from Newcomb's fundamental catalogue, the positions being reduced to an absolute system, and the values used being considered definitive. The resulting constant of refraction a was found to be $= 60''\cdot 203$, corresponding to $\mu = 1\cdot 0002924$, at 760 mm. and 0° C. During the reductions a very noticeable fact was the manner in which the observed refractions varied in accordance with the computed ones, due to the alteration of the state of the atmosphere. On examination of the normals it is quite evident that these quantities vary with the zenith distance, suggesting that the so-called constant of refraction, adopted in forming the tables, not only needs correction, but a correction for every zenith distance. C. P. B.

2018. *Projections in Stereoscopic Relief.* **E. Estanave.** (Comptes Rendus, 143. pp. 644–647, Oct. 29, 1906.)—An arrangement is described by means of which stereograms of large size may be obtained from ordinary stereoscopic views; the apparatus may also be used to project enlarged stereoscopic images in relief, and images of opaque objects, the projections being visible to several persons at the same time. The chief means employed is a suitably divided grating placed at such a distance from the screen as to allow monocular vision of two superimposed pictures, as in Ives's apparatus [see Abstract No. 54 (1905)]. G. E. A.

2019. *Method of Rapidly Calculating the Distance beyond which Everything is in Focus for a Positive Lens.* **G. L. Johnson.** (Photographic Journ. 46. pp. 329–330, Oct., 1906.)—The following rules are given for finding the hyperfocal distance of a positive lens with any stop, the hyperfocal distance being that at which the nearest object may be considered to be in the same focal plane as an object at infinity. 1. Take the square of the focal length in inches, and the result is the hyperfocal distance in feet. 2. Multiply the focal length in centimetres by aperture of lens, and the product is the hyperfocal distance in metres. G. E. A.

2020. *Calculation of the Colours displayed by Apophyllite.* **B. Trolle.** (Phys. Zeitschr. 7. pp. 700–710, Oct. 15, 1906.)—A calculation, by means of König's colour tables, of the colours which a plate of apophyllite, cut perpendicular to the axis, displays in white, convergent, polarised light. Apophyllite is a uniaxial, inactive crystal, found chiefly in the Faröe Islands and the West Indies. A plate of this crystal, examined under the above conditions, gives the usual black or white cross, according as the nicols are crossed or parallel; and the isochromatic curves are coloured rings. But in apophyllite the only colours seen in the rings are yellow-green and blue-violet, in addition to white and black, and this phenomenon is apparently repeated in all the rings, the order of colour being white, blue-violet, black, and yellow-green. Liebisch and Drude mention as the cause of this singular change of colour that the difference of refractive indices of the O and E rays is not, as usual, nearly constant, but changes with the wave-length; this may be right, but does not explain the effect. Further, there is some doubt as to the sign of the double refraction in apophyllite. According to Brauns, crystals which are positive for a given colour, say red, are negative for another, blue. Drude also mentions this. Pulfrich's numbers for the refractive indices of the O and E rays, however, show no such peculiarity, and the crystal is positive. The refractive indices of a plate of the crystal cut perpendicular to the axis are measured by an Abbe refractometer from λ668 to λ486; also the difference of the indices is measured by a polarisation spectrometer, experimental details being given. The values of $(n_2 - n_1)/\lambda$ found therefrom vary slightly, passing through a maximum at λ545. The theory of distribution of the colours is developed and applied to show that, owing to this variation, the intensity curves corresponding to different values of λ separate slowly from one another, the effect being to give, on one side of a point of maximum intensity, a region in which yellow-green preponderates, and, on the other side, a region in which the colour is blue mixed with a little red. It is also verified that the crystal is positive. G. E. A.

2021. *Errors in Weber's Photometer.* **K. Satori.** (Elektrotechnik u. Maschinenbau, 24. pp. 859–860, Oct. 28, 1906. Écl. Électr. 49. p. 320, Nov. 24, 1906.)—The author has made a very thorough investigation of the Weber photometer, and finds that the formula $I = CR^2/r^2$, in which I is the intensity of the unknown source, R its distance from the fixed milk-glass plate, and r the distance of the movable plate from the standard source, does not give correct results, C being found to be variable and not a constant. Correct results may be obtained by using the formula $I = CR^2/(r - d)^2$, where d is a constant. The author suggests that the discrepancy between the theoretical and the true formula may be due to imperfect diffusion by the movable screen. A. H.

2022. *Entoptic Vision.* **W. F. Barrett.** (Roy. Dublin Soc., Proc. 11. 12. pp. 111–136, Oct., 1906.)—The author discusses the phenomenon known as Haidinger's Tufts. Using a double pin-hole aperture in the diaphragm of the Entoptiscope [see Abstracts Nos. 882 and 1224 (1906)] and a nicol before the diaphragm, a single image, and not a double one, of the tufts is perceived. This proves that their origin is in the retina. Moreover, they are exactly coincident in position with the yellow spot of the retina. By introducing a light-filter which transmits light containing no yellow rays, an observer is able to see the yellow spot in his own eye as a dark patch on the entoptiscope screen. The longer axis of the "tufts" is practically coincident with the diam. of the yellow spot, 0·8 mm. The phenomenon is not therefore restricted to the *fovea centralis*, whose greatest length does not exceed 0·2 mm. The horizontal diam. of the macula is, as a rule, slightly greater than the vertical. The angle subtended by it is a little over 8°. The dimensions of the blind spot measured in three individuals were found to vary slightly, but agreed fairly well with the average obtained by other observers. Lastly, the author describes Purkinje's figures or shadows of the retinal vessels as seen entoptically, and moving corpuscles which are probably due to the white corpuscles of the blood, and are seen as actively moving points of light. **H. W. P. Y.**

2023. *Relative Illuminating Values of the Carcel, Hefner, and Vernon Harcourt Lamps.* **A. Perot** and **Laporte.** (Comptes Rendus, 143. pp. 743–744, Nov. 12, 1906.)—The mean values of the results obtained from the tests made on the French, German, and English standards of light are given. The tests at the *Conservatoire national des Arts et Métiers* were made by Perot and Langlet, and at the *Laboratoire central d'Électricité* by Laporte and Jouaust. Direct comparisons were made of the three lamps and also indirect comparisons by means of an intermediate electric lamp. It was found that the humidity of the air appreciably affected the light emitted by the Carcel lamp. Hence making this correction and thus altering some of the figures given in Abstract No. 1852 (1906) the final results are as follows :—

Measurement.	Harcourt/Carcel.	Hefner/Carcel.	Hefner/Harcourt.
Direct	1·009	0·0932	0·0933
Indirect	1·000	0·0929	0·0929

With indirect measurements the product Harcourt/Carcel × Carcel/Hefner × Hefner/Harcourt equals unity. If the colours of the sources compared influence the measurements then this product need not be unity. This effect, if it exists, is so small that it was entirely masked by the errors of observation. Hence each source may be defined by a number, although that number is the result of a physiological impression. The following table gives the final results obtained by taking the mean of the figures given above :—

	Carcel.	Harcourt.	Hefner.
Carcel........................	1	1·004	0·0930
Harcourt	0·996	1	0·0931
Hefner	10·75	10·74	1

The difficulties of making exact measurements with flame standards are commented on, and the desirability of having a standard, like the Violle, which would be less affected by external conditions, is again pointed out. **A. R.**

2024. *Temperature and Selective Radiation of Glow-lamps.* **C. W. Waidner** and **G. K. Burgess.** (Electrical World, 48. pp. 915–917, Nov. 10, 1906. Communication from the Bureau of Standards.)—The high efficiency of metal filament lamps raises the question as to whether this is due to selective radiation or high temperature, or to both these causes. As practically no experimental data, at very high temperatures, are available, the authors communicate some preliminary results obtained with carbon, tantalum, and tungsten filaments. The temperature of the filament was measured by comparing it with a carbon ribbon the temperature of which could be varied, and the equivalent black body temperature of which was found experimentally by the Holborn-Kurlbaum optical pyrometer [Abstract No. 2122 (1901)]. As an illustration of selective radiation the following results for platinum are given :—

Temperature in Deg. Cent.	Black Body Temperatures.		
	Red ($\lambda = 0\cdot66\mu$).	Green ($\lambda = 0\cdot55\mu$).	Blue ($\lambda = 0\cdot47\mu$).
1100	1008	1029	—
1400	1255	1285	1300
1700	1505	1545	1575

It will be seen that the energy of luminous radiation is distributed more favourably for platinum than for a black body. The current-temperature equations for four tungsten filament lamps are as follows :—

Lamp No.	Colour.	Equation.
1	Red	$C = 1\cdot008 - 0\cdot0_3891t + 0\cdot0_6548t^2$
5	Red	$C = 1\cdot344 - 0\cdot0_3396t + 0\cdot0_6518t^2$
10	Red	$C = 0\cdot802 - 0\cdot0_3487t + 0\cdot0_6490t^2$
10	Green	$C = 0\cdot775 - 0\cdot0_3390t + 0\cdot0_6465t^2$
10	Blue	$C = 0\cdot644 - 0\cdot0_3225t + 0\cdot0_6411t^2$
11	Red	$C = -0\cdot028 + 0\cdot0_3104t + 0\cdot0_7990t^2$
11	Green	$C = -0\cdot060 + 0\cdot0_3162t + 0\cdot0_7781t^2$
11	Blue	$C = -0\cdot056 + 0\cdot0_3148t + 0\cdot0_7778t^2$

1, 5, and 10 were low-voltage experimental lamps. The equations give the actual black-body temperatures with great precision. At 100 volts the current in No. 11 was 0·644 amp.; its black-body temperature was then 2,185° C., indicating a true temperature of about 2,300° C. The selective radiation of tungsten filaments is illustrated by the following table :—

Lamp No.	Black Body Temperatures.			Temp. Cent.
	Red ($\lambda = 0\cdot66\mu$).	Green ($\lambda = 0\cdot55\mu$).	Blue ($\lambda = 0\cdot47\mu$).	
10	1300	1310	1319	1355
11	1300	1311	1319	1355
10	1700	1714	1723	1770
11	1700	1724	1734	1800
10	2100	2123	2141	2220
11	2100	2146	2161	2280
10	2500	2532	2565	2690
11	2500	2576	2594	2780
10	2900	2943	2994	3180

The appearance of the filament of lamp No. 11 when cold was more polished than that of No. 10, and the table shows that No. 11 acts more like platinum. By noticing the current at which the lamp burnt out and substituting in the current-temperature equation it was found that lamps Nos. 1 and 5 burned out at 2,950° and 2,850° respectively. This indicates that the melting-point of tungsten may be taken as 3,200° C., and that it has the highest melting-point of any metal yet discovered. With a tantalum lamp the following results were obtained :—

Temp. Cent.	Black Body Temperatures.		
	Red ($\lambda = 0\cdot66\mu$).	Green ($\lambda = 0\cdot55\mu$).	Blue ($\lambda = 0\cdot47\mu$).
1360	1300	1320	1330
1800	1700	1727	1752
2300	2100	2147	2198

Tables of current-temperature equations are also given for carbon filament lamps. The following table gives the normal burning temperatures of both the metal and carbon filament lamps :—

Type.	Watts.	Volts.	Black Body Temp. λ = 0·66μ.	Temp. Cent.
Carbon	4	50	1710	1800
Carbon	3·5	118	1760	1850
Carbon	3·1	118	1860	1950
Tantalum	2·0	110	1865	2000
Tungsten	0·95	100	2185	2300

No conclusive experimental evidence has yet been adduced to disprove the statement that at a given temperature the total energy of every kind of radiation from a black body per unit area is greater than that of any other body. Of all metals, platinum departs furthest from black-body radiation. For a given true temperature it radiates less total energy, and a greater proportion of the energy is radiated by the shorter wave-lengths which produce luminous impressions. The authors' results show, however, that selective radiation is not the reason why tungsten lamps are more efficient than tantalum lamps. The selective radiation is less for tungsten, but the tungsten filaments are at a much higher temperature. The authors consider that the very considerable gain in efficiency of the metal filament lamps over the carbon filament lamps is mainly due to the much higher working temperatures of the latter. A. R.

2025. *Photographic Action of Ionised Air.* **C. E. S. Phillips.** (Electrician, 57. p. 828, Sept. 7, 1906.)—Taking due precautions against the presence of emanation or secondary radiation, an exposure of 15 hours to a stream of ionised air gave a clearly-defined darkening upon a senstive plate after development. J. J. S.

2026. *Polarimetric Sensibility and Accuracy.* **P. G. Nutting.** (Bureau of Standards, Bull. 2. pp. 249–260, Aug., 1906.)—This paper contains a theoretical investigation into polarimetric instruments and methods, and deals, amongst other points, with the conditions for maximum sensibility and accuracy. The author shows that unsymmetrical sources, especially double unsymmetrical sources like the sodium lines, should be avoided.

E. C. C. B.

2027. *The Sparking Apparatus of C. Auer.* **P. Zonta.** (N. Cimento, 11. pp. 347–350, May and June, 1906.)—The author describes the sparking apparatus due to C. Auer, and given in Kayser's "Handbuch der Spectroscopie" (p. 183). Instead of the ordinary induction coil, an electromagnet is in series with a secondary battery and two other circuits in parallel, the first of which includes the ordinary contact interrupter actuated by a soft-iron armature, and the second a circuit including an interrupter of a different type actuated by the same armature. A piece of carbon rod impregnated with a solution of the salt that it is required to examine spectroscopically is fixed so as to project vertically downwards, and a piece of platinum wire attached to the arm of the armature rubs against this, its position being so arranged that it leaves the end of the carbon rod just after the first interrupter breaks its circuit. The salt is then vapourised, a bright flash being produced. The spectrum is more of the character of that produced by the arc than that by the ordinary spark, but the method has the advantage over the arc, in that a small amount only of a solution of the substance is required, instead of a considerable quantity of it. The spectra of Ba, Sr, K, and Li are reproduced, together with those produced by the arc method, the differences being small. The author intends later to obtain the spectrum of radium in this way. S. G. S.

2028. *Spectrum-line Structure.* **P. G. Nutting.** (Astrophys. Journ. 24. pp. 111–124, Sept., 1906.)—In continuation of his former papers [see Abstracts Nos. 704, 1058 (1906)] the author now treats of the relationship existing beween the widths and intensities of normal lines. The widths of the spectrum lines were measured with an echelon provided with a micrometer eyepiece, and the intensities with a special spectrophotometer. Details are given of the structure of the chief lines of the following elements: Li, Na, K, Rb, Mg, Ca, Sr, Ba, Ti, Ce, Th, V, Cr, Mo, W, U, Mn, Fe, Co, Ni, Pd, Pt, Rh, Os, Cu, Ag, Au, Ir, Zn, Cd, Hg, Tl, Sn, Pb, Bi. Roughly speaking, excepting Ca and Mn, the lines of all the spectra in which lines are excessively numerous are normal, while the lines of the simple spectra (except Au, In, and Mg) are composite. The remainder of the paper goes on to discuss the behaviour of the normal lines, leaving the others for a future investigation. Apart from variations of pressure, the width of a normal line appears to depend on the intensity alone. The minimum width at atmospheric pressure is about 0·04 tenth-metre, and is the same or nearly so for all lines; at low pressures the minimum width decreases to 0·005 tenth-metre. This work will provide useful material for the suitable selection of standard lines for the new absolute determinations of wave-length. C. P. B.

2029. *Photographs of Arc Spectra.* **Blythswood** and **W. A. Scoble.** (Astrophys. Journ. 24. pp. 125–127, Sept., 1906.)—The series of photographs were taken to test the new gratings ruled on the Blythswood machine, and extend from λ5800 to λ8500. Interesting experiments were made with the new red sensitisers in comparison with the old alizarine blue, and it was found that by a special mode of preparation the latter material gave excellent results. C. P. B.

2030. *Absorption Spectra of the Rare Earths.* **A. Langlet.** (Zeitschr. Phys. Chem. 56. pp. 624–644, Sept. 7, 1906. Chem. Laborat. des Chalmerschen Polytechnikums, Gothenburg, June, 1906.)—An investigation into the absorption spectra of the rare earths, more particularly praseodymium, with a view of testing the validity of the ionic theory as an explanation of these phenomena. The conclusions arrived at may be summarised as follows: Aqueous solutions of different salts of the same metal, when sufficiently diluted, have identical spectra at equal optical thicknesses; the spectra of such dilute solutions are spectra of the ions. Beer's law holds for dilute but not for concentrated solutions. Changes in the amount of electrolytic dissociation produce corresponding changes in the absorption spectrum which are different for different salts. E. C. C. B.

2031. *Studies in Luminescence.* VII. *Further Experiments on the Decay of Phosphorescence in Sidot Blende and certain other Substances.* **E. L. Nichols** and **E. Merritt.** (Phys. Rev. 23. pp. 37–54, July, 1906.)—Hitherto the measurements had been made in definite spectral regions by means of a spectrophotometer; in order, however, to enable the rate of decay to be observed over longer intervals it has been found necessary to measure the total light. In the case of the Sidot blende and the substances dealt with, this was found to affect the measurement in a very small degree, since the phosphorescence spectrum consists in the main of a single band. The results recorded in this paper are of considerable importance, for they vitiate much of the author's previous work, owing to their having discovered that the curve of decay depends very largely upon the time of excitation. Evidence of hysteresis has also been found. The author's results may be expressed as follows. The curve obtained by plotting the values of $I^{-\frac{1}{2}}$ as ordinates and the corresponding values of t as abscissæ is a straight line for small values of t; as t increases it changes to a curve concave toward the t-axis. For still larger values of t the relation between $I^{-\frac{1}{2}}$ and t is again linear. Not only the intensity of phosphoresence, but also the form of the decay curve is dependent on the intensity and duration of the excitation. The slant is altered in each of the straight parts of the curve by changing either of these two factors in the excitation. The behaviour of the phorphorescent substance with a given excitation depends upon its previous history. Some semi-permanent change is produced by excitation, which persists for several hours or even several days after visible phosphorescence has ceased. In the case of Sidot blende the semi-permanent condition may be destroyed and the screen restored to a standard state by brief exposure to the red and infra-red rays.

E. C. C. B.

2032. *Fluorescence, Magnetic Rotation, and Temperature Emission Spectra of Iodine Vapour.* **R. W. Wood.** (Phil. Mag. 12. pp. 329–336, Oct., 1906.)—The fluorescence of iodine vapour was observed by focussing a beam of light from the sun or arc at the centre of a bulb containing iodine vapour. It is necessary that little or no other gas be present, and it was found that no heat is required, the pressure of the vapour being sufficient at ordinary temperatures. The spectrum of the fluorescence was photographed with a three-prism spectrograph and is reproduced in the paper. Some visual observations showed that the colour of the fluorescence varies with the wave-length of the exciting light. The experiments show that the fluorescence spectrum covers the exciting region and extends to a short distance on the red side of it. The magnetic rotation spectrum was photographed with a 12-ft. concave grating, and at certain points appears to be the complement of the absorption spectrum. The author has not been able to observe the doubling of the magnetic lines. The temperature-emission spectrum was observed by heating a quartz vessel in a blast flame; the vessel is exhausted of air, but contains a fragment of iodine in a side tube which is gently warmed. This spectrum is remarkably like the fluorescence spectrum, but the bands of the former are somewhat nearer the red.

E. C. C. B.

2033. *Polarisation of Röntgen Rays.* **H. Haga.** (Konink. Akad. Wetensch. Amsterdam, Versl. 15. pp. 64–68, July 20, 1906. Proc. 9. pp. 104–109, Aug. 21, 1906.)—The author has examined the behaviour of Röntgen rays by a photographic method and has confirmed some of Barkla's results [Abstract No. 1234 (1906)]. He draws the following deductions from his experiments: (1) The primary Röntgen rays are polarised at the utmost only to a very slight amount; (2) *Possibly* an asymmetry in the arrangement caused the maxima and minima observed in the experiments of Barkla, who did not observe at the same time in two diametrically opposite directions. By means of photographic action the result reached by Barkla with the use of electroscopes was confirmed, and the secondary rays emitted by carbon were shown to be polarised. The agreement makes it probable that the Röntgen rays consist of *transverse* vibrations. Moreover, in some of the experiments described, the supposition of a *longitudinal* vibration of the primary Röntgen rays would lead to a maximum action of the tertiary rays in a vertical plane and not in a horizontal plane, as was the case. J. J. S.

2034. *Secondary Rays caused by very Soft Röntgen Rays.* **W. Seitz.** (Phys. Zeitschr. 7. pp. 689–692, Oct. 15, 1906. Phys. Inst., Würzburg, Sept., 1906. Écl. Électr. 49. pp. 840–841, Dec. 1, 1906.)—If a small Röntgen-ray tube be provided with an aluminium window and exposed to a pressure of about 400 volts, Röntgen rays may be generated which are unable to penetrate the glass wall of the tube but to which the Al-foil is quite transparent. These soft rays differ from those generated at higher pressures only in degree and not in nature, and exhibit practically all the known properties of Röntgen rays. After the author's previous observation of their diffuse spreading in the atmosphere it seemed desirable to ascertain whether they were able, on striking a solid body, to generate secondary rays, and if so, of what kind. It is now found that secondary rays are generated by these soft Röntgen rays, and that they consist in part of Röntgen rays and in part of projected electrons. [See also Abstracts Nos. 94 and 848 (1906).] E. H. B.

2035. *Energy of Röntgen Rays.* **E. Angerer.** (Ann. d. Physik, 21. 1. pp. 87–117, Oct. 25, 1906. Extract from Inaug. Dissertation, München. Écl. Électr. 49. p. 339, Dec. 1, 1906.)—The author redetermines the energy of Röntgen rays by means of a platinum bolometer, and finds an emission of 0·15 mgm.-cal. for a single discharge, this being somewhat less than previous values. The Röntgen-ray energy grows much more rapidly than that of the primary current in the inductor. The more intense radiation is obtained with a primary current of 4·15 amps. at 110 volts. Of the electric energy supplied to the Röntgen-ray tube about 0·2 per cent. is converted into Röntgen-ray energy, and the quantity of electricity generated in a Dorn-Curie tube by Röntgen rays is proportional to the energy of these rays as measured by means of the bolometer. The emission of Röntgen rays by the antikathode at every discharge is not, as a rule, an isolated event. In four cases out of five a second discharge follows the first at an interval of about 0·0008 sec. The main discharge lasts about 0·00038 sec., and the second discharge 0·0002 sec. The energy per sec. is therefore 0·26 gm.-cal. The author reproduces photographic records of the discharges, of which there were about 100 per sec. E. E. F.

2036. *Application of Tele-objective Method to Canal Rays.* **B. Strasser** and **M. Wien.** (Phys. Zeitschr. 7. pp. 744–746; Discussion, pp. 746–748, Nov. 1, 1906. Paper read before the 78 Naturforscherversamml., Stuttgart, Sept. 16–22, 1906. Deutsch. Phys. Gesell., Verh. 8. 20. pp. 537–542, Oct. 30, 1906.)—The path of the canal rays is inclined at an angle of about 45° to the axis of a large lens which produces an image of any part of the stream of canal rays desired, upon the slit of the spectroscope. Also a mirror is situated with its plane at right angles to the axis of the lens, so that the image of the canal rays sends light to the spectroscope. In this way both the ordinary doubling due to the Doppler-effect [Abstract No. 297 (1906)], and an additional line on the other side of the normal line are produced. By employing varying voltages for the production of the canal rays, the authors attempted to bring the "Doppler" lines nearer to the undisplaced line, but always failed to bridge the gap between the two. Hence it is concluded that, either canal rays possessing less than a certain velocity do not exist or else they do not emit light at these low velocities. It was then attempted to obtain a well-defined "Doppler" line by using a plane sheet of rays emerging from a slit in the kathode and using light from a narrow strip of this sheet; however, the line was no better defined than before, showing that even immediately behind the kathode the rays possess very different velocities. The authors next endeavoured to obtain a Doppler-effect in front of the kathode, by means of light from the first kathode glow, but failed to do so except when the image of the kathode itself fell upon the slit: this effect they consider to be due to the light from behind the kathode passing through the apertures and so reaching the spectroscope. In the *discussion* which followed, **Gans** pointed out that from the mirror experiment a limit might be obtained for the velocity of the earth through the ether, according to Lorentz's theory. **Kaufmann** called attention to the fact that the absence of canal rays having less than a certain velocity may be explained on the Bragg-Kleeman hypothesis that the α-rays suddenly lose their velocity. **Stark** considered that the authors would have obtained the Doppler-effect in the light from the first kathodic layer if they had employed sufficiently high voltages, as he had obtained it using 5,000 volts instead of 3,000 as employed by the authors. S. G. S.

2037. *Absorption of Uranium β-Rays.* **J. A. Crowther.** (Phil. Mag. 12. pp. 379-392, Oct., 1906.)—The author regards the absorption of β-rays as due to the electrons within the atom, and shows that the absorption per electron is proportional to λ/ρ, where λ is the coefficient of absorption and ρ the density of the absorbing substance. He made determinations of the absorption of β-rays of uranium for 30 different elements, measuring the relative intensity of the rays by their ionisation. The uranium oxide was contained in a depression in a lead plate covered with thin Al-foil to intercept the α-rays, and thin plates of the substances tested were laid on the aluminium. The whole was enclosed in a box containing two vertical parallel condenser plates, between which the current was maintained. On plotting the values of λ/ρ against the atomic weights, it is seen that they describe a series of pointed curves resembling those of the periodic system of chemistry, and, indeed, strictly corresponding to them, max. values for λ/ρ being associated with the elements S, Se, Te, and Pb. In the case of compounds, the absorption may be calculated on the assumption that the absorption per molecule equals the product of the average absorption per electron multiplied by the number of electrons in the molecule. E. E. F.

2038. *Ionisation Ranges of the α-rays of Actinium.* **O. Hahn.** (Phil. Mag. 12. pp. 244-254, Sept., 1906. Phys. Zeitschr. 7. pp. 557-563, Aug. 15, 1906. Écl. Électr. 48. pp. 378-381, Sept. 8, 1906.)—An account is given of the determination of the ranges in air of the α-particles from (1) an active deposit of actinium, (2) actinium X, (3) radio-actinium, (4) actinium emanation. The apparatus used was the same as previously employed for thorium, and resembled that used by Bragg and Kleeman for radium products. From the observations made, the ionisation-distance curve of the active deposit of actinium was obtained. From its shape it is seen that the active deposit of actinium contains only one α-ray product. The ionisation of the α-rays begins at a distance of 5·50 cm., increases very rapidly, reaches a maximum at about 3·6 cm., and decreases slowly with the distance from the source. The active deposit of thorium emits two different kinds of α-rays: there is thus a difference between the disintegration series of thorium and actinium. The α-particles of actinium X were found to have an ionisation range in air of about 6·55 cm. Radio-actinium is intermediate between actinium and actinium X. The curve obtained for it has the characteristic shape for a thin film of a single α-ray product. The max. range of the α-rays is 4·8 cm. Radio-actinium emits only α-rays, and is half-transformed in 20 days approximately. On examining the behaviour of actinium emanation by the same method as was previously employed for thorium emanation, the range at which the α-particles cease to ionise the air was found to be about 5·8 cm. The following table gives the ranges of the α-ray products of actinium. The ranges of the products of thorium and radium are added for comparison:—

Product.	Range of α-particles in cm. in air for atmospheric pressure and temperature	Product.	Range.	Product.	Range.
Radio-actinium ...	4·8 cm.	Radio-thorium...	3·9 cm.	Radium...........	3·50 cm.
Actinium X........	6·55 „	Thorium X	5·7 „	Emanation.......	4·33 „
Emanation.........	5·8 „	Emanation	5·5 „	Radium A.........	4·83 „
Actinium B........	5·50 „	Thorium B........	5·0 „	Radium C.........	7·06 „
		Thorium C........	8·6 „	Radium F.........	3·86 „

The ranges of the α-particles from thorium differ among each other to a greater extent than those of radium, and the latter to a greater extent than those of actinium. On arranging the products in the order of magnitude of the ranges of their α-particles, it is seen that each of the products of thorium and actinium occupies a corresponding place in the table. There appears to be a close connection in the mode of transformation of the atoms of thorium and actinium. J. J. S.

REFERENCES.

2039. *Geometrical Theory of Optical Imagery.* **J. P. C. Southall.** (Astrophys. Journ. 24. pp. 156–184, Oct., 1906.)—From the general image equations of Czapski, which involve no assumption as to the apparatus itself, and no restrictions as to the position, form, or dimensions of the object, nor as to the angular aperture of the "imaging" bundle of rays, all the laws of optical imagery can be deduced. These equations form the starting-point of the present theory which uses the methods of projective geometry in giving an outline of Abbe's theory. The first part of the paper deals with the collineation of two plane fields, and the second part with the elementary problems of geometrical optics. G. E. A.

2040. *Interference Bands produced by a Grating placed near a Thin Plate.* **G. Meslin.** (Journ. de Physique, 5. pp. 725–748, Nov., 1906.)—A more complete account [see Abstract No. 1225 (1906)].

2041. *Cause of Fogging of Plates in Tropical Climates.* **J. McDowall.** (Chem. News, 94. p. 209, Nov. 2, 1906.)—From tests of a plate at 40° C., the average temperature of Upper Egypt in summer, fogging is ascribed to vapours, occluded in the wood of the dark slide at ordinary temperatures, which exhale when the wood is heated. G. E. A.

HEAT.

2042. *Simple Method of Photographing Heat Rays.* **J. Zenneck.** (Deutsch. Phys. Gesell., Verh. 8. 20. pp. 490–498, Oct. 30, 1906. Paper read before the 78 Naturforscherversamml., Stuttgart, Sept. 18, 1906. Phys. Zeitschr. 7. pp. 907–908; Discussion, p. 909, Dec. 1, 1906.)—Based upon the known fact that some developers have practically no action on the sensitive plate at low temperatures, the author has developed a method of photographing the heat rays emitted by various heated substances. A plate previously exposed to the light is placed in a cold developer (which does not darken it); the plate is then removed from the bath, and the rays from some warm body are allowed to fall upon it, through a diaphragm. Only the places upon which these rays impinge, thus warming them, become blackened, and by this means a picture of the diaphragm is obtained. As developers hydroquinone and glycin are suitable; any plate can apparently be used. Better results are obtained by having first a warm and then a cold developing bath. Three photographic reproductions are given. L. H. W.

2043. *Determination of Melting-points by the Optical Method.* **C. Doelter.** (Zeitschr. Elektrochem. 12. pp. 617–621, Aug. 17, 1906.)—The author has investigated the melting temperatures of a number of natural and artificial silicates by means of a combination of a low-power microscope with a small electric oven, the temperature of the specimen examined being determined by means of a thermo-junction. A good agreement was obtained between the melting temperatures of the natural and artificial minerals, but the values recorded were considerably lower than those given by Day and Allen [Abstract No. 1798 (1905)]. Thus for a labradorite the range over which the melting extended was 1,190° to 1,240° C., whilst Day and Allen give for incipient melting 1,463° C. For anorthite the range was 1,255° to 1,340° instead of 1,532° C., for albite 1,130° to 1,215° instead of 1,225° C., and for oligoklase 1,160° to 1,240° instead of 1,360° C. On general grounds the author considers his lower figures as more probably correct. T. M. L.

2044. *Freezing of Water in Sealed Tubes.* **H. A. Miers** and **Miss F. Isaac.** (Chem. News, 94. pp. 89–90, Aug. 24, 1906. Abstract of paper read before the British Assoc. at York.)—In a cooling supersaturated solution in which a few crystals are growing while it is being stirred, the refractive index rises until, at a certain temperature it attains a maximum value and then suddenly falls; at this moment also profuse crystallisation takes place. This is the temperature of *spontaneous* crystallisation. Experiments are described in which water contained in sealed tubes was violently and continuously shaken in a bath of brine. The brine was steadily cooled, its temperature falling at the rate of about 2° an hour. The tubes containing tap-water, ordinary distilled water, or pure water froze between − 2° C. and − 1·6° C., the mean for the experiments being − 1·86°, and for the pure water − 1·9°. The ice generally makes its appearance at the bottom of the tube, and grows very rapidly at first in star-like crystals, and then in a cloudy shower which spreads up through the tube. The authors conclude that − 1·9° C. is the temperature at which, under atmospheric pressure pure water freezes spontaneously, *i.e.*, in the absence of solid particles of ice. It is noteworthy that this same temperature is that at which, according to Pulfrich, super-cooled water possesses a maximum refractive index. J. J. S.

2045. *Temperature of Incandescent Carbon Particles in Luminous Flames.* **R. Ladenburg.** (Phys. Zeitschr. 7. pp. 697–700, Oct. 15, 1906. From the Phys. Inst. d. techn. Hochschule, Charlottenburg.)—The emissive and absorptive powers of the flames of a Hefner and an acetylene lamp are measured by mirror spectrometer, quartz prism, thermo-pile and galvanometer. In determining the absorption by the flame, the radiation of a Nernst lamp was reflected from a concave mirror through the flame on to a slit of known size, from which, after another reflection, it passed to the spectrometer slit. The gas burnt in the acetylene flame was purified by passage through acagin (lead bichromate mixed with calcium chloride). Curves are given showing the distribution of energy in the flames, and the calculated energy distribution in the "black" flames, *i.e.*, energy curves of bodies which, at the temperature of the glowing carbon particles in the given flame, possess unit absorptive power. From the latter curves the values of $\lambda_{max.}$ give, by means of the equation $\lambda_{max.} \times T = 2940$, the temperatures of the carbon particles in the Hefner and acetylene flames as 1,405° C., and 1,842° C. respectively. By measuring the "black" temperature, T_b, with an optical pyrometer, the true temperature, T_t, is verified, knowing the absorptive power A, by means of the equation, $1/T_t = 1/T_b + (\lambda/c) \log_e A$, where c is 14,600. The two values thus found are 1,431° C., and 1,831° C. The former is in good agreement with Kurlbaum's value for a candle flame (1,417), and the latter with the corrected value of Nichols for acetylene (1,845). [See also Abstracts Nos. 808, 1482 (1899), 1625 (1900), 1820 (1902), and 1596 (1906).] G. E. A.

2046. *Calibration of a Berthelot Combustion Calorimeter.* **W. Jaeger** and **H. v. Steinwehr.** (Ann. d. Physik, 21. 1. pp. 23–63, Oct. 25, 1906. Communication from the Physikal.-Techn. Reichsanstalt.)—Describes in great detail the calibration of a Berthelot bomb calorimeter in electrical units by means of platinum thermometers, the temperature measurements being pushed to an accuracy of 0·0001° C. The method used consists in applying a known quantity of electrical energy to the calorimeter by means of a resistance-coil placed just outside the bomb, a time-temperature curve being taken from the steady state before the commencement of the experiment until a steady state is again attained, the rise of temperature being approximately 2° C. The corrections arising from thermal lag between the water and the metal parts of the calorimeter, as well as the lag of the thermometer, are carefully considered and determined by special cooling experiments made with the separate parts of the apparatus. The platinum thermometer used consisted of a single loop of platinum wire insulated with silk and shellac, and enclosed in a thin brass tube, the purpose of this form being to reduce the lag of the thermometer as far as possible. Tabular values of the water-equivalents thu determined are given. W. Ros

2047. *Speed of Detonation of Explosives.* **Dautriche.** (Comptes Rendus, 143. pp. 641–644, Oct. 29, 1906.)—In place of a chronograph the author employs a fuse, along which the speed of detonation is constant (about 6,500 m. per sec.). A detonation will take equal times to traverse equal lengths of two similar fuses, but if in the course of the fuses different lengths of the explosive to be examined are inserted, one of the fuses will have to be lengthened to compensate for the different retardations or accelerations so introduced, and the speed of detonation in the explosive can thus be calculated. The explosive is introduced into both circuits, so as to compensate any retardation that may occur on passage of detonation between the fuse and the explosive. In experiments made with cheddite, of densities from 0·7 to 1·38, the explosive was contained in zinc tubes of 2 cm. diameter, and of 50 and 5 cm. useful length respectively, and the speed of detonation was found to be a maximum for a density of about 1·1.

R. E. B.

2048. *Vapour Pressure of CO_2 at Low Temperatures.* **J. Zeleny** and **R. H. Smith.** (Phys. Zeitschr. 7. pp. 667–671, Oct. 1, 1906. Translation from English.)—The CO_2 investigated had no more than 1/40 per cent. of impurity, and its temperatures were determined by use of an iron-nickel thermoelectric junction gauged at six known temperatures varying from 29·2° C. to that of liquid air under given circumstances. The vapour pressures of liquid CO_2 were measured at temperatures from −7° to −65·5°, and those of solid CO_2 from −56·4 to −134°, the results found being in close agreement with those obtained by Kuenen and Robson, and by du Bois and Wills. The triple point was found to be −56·4°, and the corresponding pressure 5·11 atmos., and the measures give 140 as the latent heat of sublimation. The following are the vapour pressures in cm. of mercury found for the corresponding temperatures C.:—

Liquid.				Solid.			
−10	1,963	−50	511·5	−56·4	391	− 80	65·7
20	1,483	56·4	391·1	60	298	90	28·8
30	1,080	60	330·6	65	210	100	11·9
40	751	65·5	250·8	66	195·5	110	4·3
				70	144	120	1·4
				78·2	76	130	0·25

Some of the observations indicated that air is dissolved by CO_2 in its solid state, which on evaporation gives it off.

R. E. B.

REFERENCES.

2049. *Guldberg and Waage's Mass Law.* **T. B. Robertson.** (Journ. Phys. Chem. 10. pp. 521–523, Oct., 1906.)—The train of reasoning which deduces this law for systems obeying the condition $pv = RT$ shows that the law also holds good for systems in which $p(v-b) = RT$.

R. E. B.

2050. *Deduction of Wien's Law.* **P. Ehrenfest.** (Phys. Zeitschr. 7. pp. 527–528, Aug. 1, 1906.) **J. H. Jeans.** (Ibid. p. 667, Oct. 1, 1906. From the English.)—Ehrenfest criticises Jeans' method of deducing this law. [See Abstract No. 332 (1906).] Jeans, while admitting that the method contains an unproved assumption—as indeed he originally stated—shows the particular criticism to be mathematically bad.

R. E. B.

2051. *Liquid Air and Charcoal at Low Temperatures.* **J. Dewar.** (Engineering, 81. pp. 796–797, June 15, 1906. From lecture delivered at the Royal Institution, June 8, 1906.)—A summary of the author's work on this subject, with experiments.

SOUND.

2052. *Velocity of Sound in Gases at Temperature of Liquid Air.* **S. R. Cook.** (Phys. Rev. 23. pp. 212–237, Sept., 1906.)—The method used was that of the double Kundt tube, one sound-tube being at ordinary temperature, the other in a bath of liquid air combined in a Dewar bulb tube. The temperatures were read electrically by resistance thermometers. In air at 90·7° C. absolute the speed of sound was found to be 18,152 cm./sec., whereas by the formula $u = u_0\sqrt{1 + at}$ it would be 19,170 cm./sec. Oxygen at 88·4° C. abs. showed a velocity of sound of 17,868 cm./sec., against the theoretical value of 18,000 cm./sec. In air at 90·7° abs. the ratio of the specific heats was determined as 1·342, taking 1·408 as the value at normal temperature and pressure. The velocities of sound in air and oxygen were also determined for a number of temperatures intermediate between those named above and ordinary temperatures. E. H. B.

2053. *Vibrations of Piano Strings.* **J. Delemer.** (Annal. Soc. Sci. de Bruxelles, 30. 3 and 4. pp. 299–310, 1905–1906.)—Helmholtz mathematically investigated the motions of a struck string on the supposition that the pressure of the hammer varied as a sine-function of the time, its period of contact being a given fraction of that of the prime tone of the string. The present author makes the supposition that the pressure of the hammer is *constant* during the time of contact. The contrast of the results obtained on the two methods is shown below, the figures showing the *intensities* of the various partial tones.

Contact of Hammer.	Nos. of Partials.	Helmholtz.	Delemer.
3/10 of period of prime tone.	1st	100	100
	2nd	189·4	112·18
	3rd	107·9	16·66
	4th	17·3	19·84
	5th	0·0	1·46
	7th	0·0	0·0
3/7 of period of prime tone.	1st	100	100
	2nd	99·7	16·07
	3rd	8·9	45·42

E. H. B.

2054. *Absolute Measures of Sound Intensity.* **W. Zernov.** (Ann. d. Physik, 21. 1. pp. 131–140, Oct. 25, 1906. Phys. Inst. d. Univ., Moskau, July, 1906.)—Four methods have hitherto been put forward for the absolute determination of intensities of sounds, namely (1) the Rayleigh disc, which measures the energy directly; (2) the pressure of the sound-waves according to the theory of Rayleigh, and the experimental confirmation of Altberg;

(3) the refractometrical method of Toepler and Boltzmann, which gives the amplitude of the pressure-changes at a node; and (4) the Wien vibration-manometer, which measures the amplitude of the periodical changes of the air-pressure occurring where the sound-waves are reflected at a surface. The present paper is concerned with an experimental comparison of the sound-pressure method with that by use of the vibration-manometer. The source of sound was an electrically-driven tuning-fork; the values of the energy in ergs per c.cm. obtained by the two methods are as in the following table:—

Pressure Apparatus E_1.	Vibration-manometer E_2.	Ratio E_1/E_2.
0·447	0·436	1·03
0·499	0·510	0·98
0·484	0·510	0·95
0·470	0·484	0·97
0·448	0·460	0·97
0·478	0·484	0·98
0·455	0·460	0·99
0·439	0·436	1·01

Mean ratio = 0·985

Thus the two methods agree within 2 per cent., or within the errors of observations. [See also Abstract No. 126 (1906).] E. H. B.

REFERENCES.

2055. *Theories of Audition.* **P. Bonnier.** (Journ. de Physique, 5. pp. 578–592, Sept., 1906.)—The author reviews the ideas of those who regard the human ear as a resonator and then develops his theory according to which the ear is assimilated to a registrar of pressures somewhat like our registering barometers. E. H. B.

2056. *Laws of Music.* **M. Gandillot.** (Comptes Rendus, 143. pp. 375–377, Aug. 27, 1906.)—A short note in which it is sought to establish the idea that the history of musical practice may be regarded as a development of the principle that composers delight to associate sounds whose frequencies are in a simple ratio.

E. H. B.

ELECTRICITY AND MAGNETISM.

THEORY, ELECTROSTATICS, AND ATMOSPHERIC ELECTRICITY.

2057. *Electronic Theories and Kaufmann's Measurements.* **M. Planck.** (Phys. Zeitschr. 7. pp. 753–759; Discussion, pp. 759–761, Nov. 1, 1906. Paper read before the 78 Naturforscherversamml., Stuttgart, Sept. 16–22, 1906. Deutsch. Phys. Gesell., Verh. 8. 20. pp. 418–432, Oct. 30, 1906.)—The author fully develops the mathematical theory of magnetic and electrostatic deflection of electrons on the basis of Lorentz's relativity theory and Abraham's sphere theory, and compares the results with the figures given for these deflections in Kaufmann's recent experiments [Abstract No. 337 (1906)]. The following table gives under z the magnetic deflection, under y_1 the electric deflection on Abraham's theory, under y_2 the same on Lorentz's theory, and under y the value observed by Kaufmann :—

z.	y_1.	y_2.	y.
0·1354	0·0262	0·0273	0·0247
0·1930	0·0394	0·0415	0·0378
0·2423	0·0526	0·0555	0·0506
0·2930	0·0682	0·0717	0·0653
0·3423	0·0853	0·0893	0·0825
0·3930	0·1054	0·1099	0·1025
0·4446	0·1280	0·1328	0·1242
0·4926	0·1511	0·1562	0·1457
0·5522	0·1823	0·1878	0·1746

It will be seen that all the theoretical electrostatic deflections are too high, the errors being nearly twice as high by Lorentz's theory as by Abraham's. The author does not claim that this decides between the two theories, especially as the difference between them is smaller than the difference of either from the actual value. In any case it appears that Abraham's theory, which assumes an undeformable spherical electron, leads to a higher value of the electric deflection for a given magnetic deflection than does the theory of Lorentz, who assumes that the electron is shortened in the direction of its motion. This difference is the greater, the greater the magnetic deflection. If the electrons are characterised by their discharge potential instead of their magnetic deflection, then, so long as the discharge potential remains under a million volts, at a given value the electrostatic deflection deduced from Abraham's theory is always smaller than that deduced from Lorentz's theory. *Discussion.*—**Kaufmann** pointed out that Lorentz's theory leads to differences of 10 to 12 per cent., and Abraham's only to differences of 3 to 5 per cent., and that the latter might possibly be accounted for by cumulative errors. The **Author** replied that such errors, when completely allowed for, might conceivably put Lorentz's theory in a more favourable position than Abraham's. **Bucherer** surrendered his own theory of the elastic electron of constant volume, and proposed to apply the principle of the equality of action and reaction to Maxwell's equations. This would make the ether superfluous, and would permit an experimental test by projecting Becquerel rays in a direction other than normal to the electric or magnetic field. **Abraham** claimed that his theory explained the phenomena twice as well as Lorentz's theory, and had the advantage of being purely electromagnetic. The **Author** replied that there were two postulates, one that the mass of the electron is purely electromagnetic (Abraham), the other that no absolute uniform translation can be proved (Lorentz-Einstein). Even in mechanics no uniform translation can be proved to exist, and he was disinclined to postulate a thing in electrodynamics which could not be proved to exist in mechanics. E. E. F.

2058. *Electromagnetic Phenomena in Moving Media.* **G. Jaumann.** (Akad. Wiss. Wien, Sitz. Ber. 115. 2a. pp. 337–390, April, 1906.)—This is a continuation of the work begun in a previous communication [see Abstract No. 1291 (1906)], the characteristic feature being that neither the law of ponderomotive action nor Faraday's induction law is made fundamental. The following are the chief subjects dealt with: (1) The fundamental conception of the theory, namely, that motion in general has no direct influence on any electromagnetic phenomenon, the motion of the medium being supposed to work indirectly only so far as it is the cause of a deformation of the medium. (2) Generation of heat in the electromagnetic field. (3) The finite limitation of the electromagnetic field. (4) The energy equation. (5) The aberration of light. On the present theory the velocity of propagation of light along the wave normal is obtained from the quotient of the Poynting energy flux and the energy density. The ray velocity is obtained from the quotient of the total electromagnetic energy flux by the energy density. It may also be found as the vector sum of the wave normal velocity and the negative velocity of the medium. It is thus claimed that the aberration of light is explained. (6) Faraday induction phenomena. (7) The Rowland and Röntgen phenomenon. (8) Unipolar induction and Wilson's experiment. (9) The conservation of the electric magnetic charges. (10) Radiations in strong electromagnetic fields. (11) Fizeau's experiment. (12) Piezo-electricity. (13) Kundt's phenomenon. (14) Frictional electricity. (15) Relation between electrolysis and Peltier-effect. E. H. B.

2059. *Apparent Difference in Conductivity of Air for Positive and Negative Charge.* **K. Kurz.** (Phys. Zeitschr. 7. pp. 771–774; Discussion, pp. 774–775, Nov. 1, 1906. Paper read before the 78 Naturforscherversamml., Stuttgart, Sept. 16–22, 1906. Deutsch. Phys. Gesell., Verh. 8. 20. pp. 459–467, Oct. 30, 1906.)—On applying a negative potential to a wire suspended in air it is found that a radio-active deposit takes place upon it, the more rapidly the higher the negative potential, and consequently if the wire be suspended in the discharge space of an electroscope, the latter is discharged owing to this radio-active deposit. A positive potential produces no such deposit. It is then suggested that this effect may produce great disturbance when attempting to measure the conductivity of the air, a radio-active deposit being formed upon the leaves of the electroscope when these are charged negatively. The author uses a Gerdien electrometer, and first charges the leaves positively and then negatively. In the first case the rate of discharge increases directly the aspirator is actuated, and on stopping the aspirator the rate immediately falls to its original value. In the second case the value on stopping the aspirator is much higher than that before starting it, and it gradually falls to its original value. On deducting from the apparent conductivity of the air as measured by the negatively-charged electroscope the amount which is due to the radio-active deposit, the author finds that the partial conductivities of the air due to positive and negative ions are the same, and hence that the product (specific velocity of ions × number per c.cm.) is the same for both. In another experiment the discharge conductor of the electroscope is covered with a removable metallic shell, which on having the radio-active deposit formed upon it is removed and the rate of decay measured by another electroscope. This at first falls rapidly, reaches a minimum, rises nearly to its original value, and then falls nearly to zero, the total time being 160 min. In the *discussion*, **S. Meyer** suggests an explanation for the variability shown in this curve: RaC is a brittle substance easily detached from its support, while RaB clings to it. Any mechanical disturbance detaches some of the RaC and the radio-activity rises. S. G. S.

2060. *Measurement of Atmospheric Potential and Disturbances of the Earth's Electric Field.* **H. Benndorf.** (Akad. Wiss. Wien, Sitz. Ber. 115. 2a. pp. 425–456, April, 1906. From the Phys. Inst. d. k.k. Univ., Graz.)—Having investigated the disturbance of the electric field of mountains and valleys [see Abstract No. 885 (1901)], the author deals with the disturbance caused by the balloons of the observer, by telegraph posts, wires, collectors, &c. Both the balloon and the earth are regarded as rotation ellipsoids, and F. Linke's formulæ are modified. The disturbance of the field below the car can be calculated if, with the aid of a drop collector electrically connected with the balloon, the density of charge is at some point reduced to zero. For a balloon 24 m. in total height, 16 m. diam., this point should be 7 m. above the car (5 m. below the equator); there will then be no disturbance of the field 8 or 10 m. below the car. The formulæ and tables for telegraph posts, steeples, high trees of height *h*, show that the disturbance will amount to 5 or 1 per cent. respectively, when the observer is at distances *h* or 2 *h* respectively from the foot of the post. The body of the observer disturbs the field by 14 or 8 per cent. respectively, when the observer is 2 or 4 m. from the collector, which is fixed 1 m. above the surface. The disturbances of the field above vertical rods are considerable; the ebonite rod supporting the collector should therefore be made sufficiently long. The field intensity at the surface of a vertical wire, 10 m. long, 2 mm. thick, is also considerable; it amounts at heights of 2, 4, 6, 8 m. to 114, 242, 416, 748 volts/cm. in an earth field of 1 volt/cm.; at the point of the wire the field is stronger still. At the apex of a lightning conductor the field intensity is 10^6 times the intensity of the earth field. Horizontal wires, as used in determinations of radio-activity, disturb the field by their own charge, hardly at all otherwise; horizontal wires stretched in zones of high atmospheric potential may be used as high-tension batteries. The collector itself disturbs the field and takes a potential which corresponds to a lower level; errors of 5 and 10 per cent. may arise. H. B.

2061. *Effect of a Forest on the Dissipation of Electricity in the Air.* **K. Bergwitz.** (Phys. Zeitschr. 7. p. 696, Oct. 15, 1906.)—An account of experiments made July, 1906, with the Elster-Geitel dissipation apparatus in the Harz, observations being taken at the edge of the forest and within it. In the forest itself the rates of dissipation of negative and positive charges were practically equal, while at the margin, as was to be expected, negative charges were dissipated quicker than positive ones. E. H. B.

DISCHARGE AND OSCILLATIONS.

2062. *Aurora Borealis.* **C. Störmer.** (Comptes Rendus, 143. pp. 408-411, Sept. 10, 1906.)—Villard's experiments relative to the trajectories of kathode rays [see Abstracts Nos. 1429 and 1608 (1906)] are conformable to the author's general theory [Abstract No. 1604 (1906)], but represent only a particular case of what is possible, *i.e.*, wherein the trajectory is confined to a closed space. But the trajectories are in general not so confined, and this independently of the strength of the magnetic field; consequently Villard's conclusions are not well founded and do not affect Birkeland's theory. **P. Villard** (ibid. pp. 587-589, Oct. 22) replies to Störmer. [See also next Abstract.] R. E. B.

2063. *Trajectories of Electric Corpuscles in the Earth's Magnetic Field and the Aurora Borealis.* **C. Störmer.** (Comptes Rendus, 143. pp. 460-464, Oct. 1, 1906.)—In continuation of former papers [see Abstract No. 1604 (1906) and preceding Abstract] the periodic trajectories of electric corpuscles emitted from the sun and moving under the earth's magnetic influence are considered as well as those asymptotically approaching such trajectories. The periods found are of the same order of magnitude as those of the magnetic perturbations called by Eschenhagen the elementary waves of terrestrial magnetism, and this seems to indicate that the latter are due to swarms of electric corpuscles moving in trajectories which tend to become periodic. The trajectories found are on a colossal scale, which would, however, vary with the nature of the corpuscles. R. E. B.

2064. *Leakage Currents on Glass Surfaces.* **F. T. Trouton** and **C. Searle.** (Phil. Mag. 12. pp. 336-347, Oct., 1906.)—This is an attempt to find some rules governing the perplexing behaviour of leakage currents in the moisture condensed on glass surfaces. The falling-off observed in the leakage currents is due to the formation of a film of oxide on the electrode, or, in the case of platinum, of a film of gas. The alteration observed in the amount of the current on reversal is due to this oxide or gas being reduced through the action of the reversal current itself. The authors prepared a "grid" of two serrated strips of tin-foil interpenetrating each other but leaving a serrated channel of clear gas between them. They found that the initial resistance of a grid varies very rapidly during variations in the hygrometric state of the surrounding atmosphere at values above 80 per cent. of moisture, and this suggests its applicability to measuring the hygrometric state. The currents transmitted under different e.m.f.'s do not obey Ohm's law, being too high at the higher e.m.f.'s. In a very damp atmosphere minute spark-discharges may occur at a voltage as low as 100—a fact which is important from the insurance point of view. If a grid is wiped over with a minute quantity of some hygroscopic body such as glycerine, it presents a beautiful appearance under a p.d. of about 100 volts. The whole plate spangles with minute sparks, which occur at points all over the grid. E. E. F.

2065. *Arc showing Constant P.D. between the Electrodes.* **T. Romilly.** (Archives des Sciences, 21. pp. 601-616, June; and 22. pp. 19-39, July, 1906.)—The author's investigations appear to show that the most suitable lamp for investigations on the arc is the one here described having electrodes of mercury and of platinum. With such a lamp the terminal p.d. is practically independent of the time the lamp has been running, of the current, length of arc, and nature of the surrounding gas. The positive Pt electrode is a disc 1 cm. diam. and 1 cm. thick placed 1 cm. above the surface of the mercury kathode. The current employed ranged between 7 and 5 amps., a variation of 28 per cent., the corresponding variation in p.d. being only 1·6 per cent. The length of arc varied in the different experiments between 0·39 and 0·94 cm. (58 per cent. variation), the p.d. varying for this range by 3·4 per cent. With the longer arc the p.d. increases slightly with increase of current, in agreement with previous results. When the electrode distance is very small, however, a small *rise* of p.d. occurs. The gases included hydrogen, nitrogen, and dry air freed from CO_2. Glass or quartz lamps give the same results, the p.d. remaining constant so long as the lamp is in connection with the air-pump. The minimum p.d. at the terminals is, in round figures, 10·38 volts for large variation of the conditions of operation. L. H. W.

2066. *The Iron Arc.* **W. G. Cady.** (Nature, 74. pp. 443–444, Aug. 30, 1906. Elect. Rev., N.Y. 49. p. 511, Sept. 29, 1906.)—In the case of the electric arc between iron electrodes there is a certain critical p.d. at which an abrupt change takes place in the conditions of the arc. If the iron arc is started with a large external resistance and maintained at such a length that the current is well below 1 amp. there is little or no sound, and the appearance at the anode is diffuse and ill-defined. As the external resistance is gradually decreased the p.d. falls and the current rises until a certain critical value, depending on the length of arc and size of electrodes, is reached. At this point a very small decrease in external resistance suffices to cause a sudden increase in current and drop in p.d. precisely as with the carbon arc. At the same time the arc contracts, a bright spot appears on the anode, and a characteristic hissing sound begins. Further increase of current is accompanied by a *continued decrease* in p.d. The hissing stage, in fact, begins at quite a different point on the p.d.-current diagram from that in the case of the carbon arc. J. J. S.

2067. *Velocity of the Negative Rays produced when Canal Rays or Kathode Rays fall upon a Metal.* **C. Füchtbauer.** (Phys. Zeitschr. 7. pp. 748–750, Nov. 1, 1906. Paper read before the 78 Naturforscherversamml., Stuttgart, Sept. 16–22, 1906. Deutsch. Phys. Gesell., Verh. 8. 20. pp. 394–398, Oct. 30, 1906.)—[See also Abstract No. 747 (1906).] The canal rays fall upon a metal plate whose inclination to the path of the rays can be varied. Immediately opposite this plate is fixed, passing through the side of the discharge tube, a canal or passage cut in a block of metal and so situated that the canal, which constitutes an arc of a circle, lies in a plane at right angles to the path of the canal rays. A magnetic field is produced whose direction is parallel to the canal rays, and therefore perpendicular to the passage. When the field has a particular strength the negative rays given off by the plate are deflected along this canal, and fall upon a conductor connected with an electroscope. From the strength of field and curvature of path the velocity of the rays may be determined, e/m being assumed; the velocity found for these negative rays is $3{\cdot}2 \times 10^8$ to $3{\cdot}5 \times 10^8$ cm./sec., which corresponds to very-slowly-moving kathode rays. The velocity of the rays is independent of the velocity of the canal rays producing them, and also of the angle of incidence under which the rays fall upon the plate, but the quantity of the secondary rays increases with the angle of incidence. The apparatus is then rearranged for the kathode rays to fall on the plate, and it is found that the secondary rays have the same velocity as those produced by the canal rays. It is also independent of the velocity of the kathode rays, and is the same for Pt as for Al, and is independent of the angle of incidence, but the amount is greater the greater the angle of incidence. In this case, on still further increasing the strength of field, the electrometer becomes positively charged through the diffusion of positive ions, and on further increasing the field a negative charge is again detected. This is due to the kathode rays reflected by the plate. As an explanation of these properties of the secondary radiations, the author suggests that the electrons are merely liberated by the canal or kathode rays, and that their velocity is due to the energy of the metallic atoms from which they are liberated; also that they may be produced by ultra-violet light or a kind of Röntgen ray created and reabsorbed by the metal; this, however, is pure speculation. S. G. S.

2068. *Current between Parallel Plates at Low Pressure.* **J. A. Brown.** (Phil. Mag. 12. pp. 210–232, Sept., 1906.)—Using for the discharge tube a glass ring closed at the ends by means of carefully-turned metal plates to act as electrodes, the author finds the relation between p.d. and steady current, the gas being hydrogen. The relation between the current and the p.d. required to maintain it is complicated. At moderately low pressures the p.d. falls with increasing current, and approaches a limiting value. As the pressure is diminished this fall gets less until, below a certain critical pressure, the p.d. rises from the start. The results are found to be in accordance with Townsend's theory. In the second part of the paper some of the peculiarities of working the discharge are pointed out; (A) The necessity for using a source of high e.m.f. with adjustable high resistance in series; (B) the effect of varying the metal of the electrode; and (C) the effect of reversing the direction of the current. S. G. S.

2069. *Spark-coil with Mercury Break.* **H. Schnell.** (Ann. d. Physik, 21. 1. pp. 1–22, Oct. 25, 1906.)—The motor which actuates the mercury break also gives a mirror an oscillatory movement which is synchronous with the mercury break. An oscillograph, which can be placed in either primary or secondary circuit of the coil, reflects a beam of light on to this mirror, which gives it an angular motion at right angles to that given by the oscillograph; the image of a small source is produced on a photographic plate, and on account of the two motions at right angles given by the oscillograph and the mirror, the character of the current in primary or secondary can be determined. The photographs obtained are reproduced in the paper, and indicate the variation in the primary and secondary currents as the constants of the two circuits are changed; on all the curves small oscillations whose periodicity is that of the natural vibration of the moving part of the oscillograph can be observed, but the amplitude is so small that no appreciable disturbance is produced. The break has a condenser in parallel with it, and the effect of the capacity of this condenser upon the amplitude and frequency of the primary, on breaking the circuit, the secondary having been removed, is at once observable. On placing the secondary in position and short-circuiting it the oscillations in the primary current become very small. The current in the secondary proving too small to produce any deflection in the oscillograph, a step-down transformer had to be employed; the current in the secondary is then seen to perform several oscillations on the break occurring in the primary, the damping being greater the greater the resistance in the secondary circuit. The difference in current-form for the short gap discharge with "aureola" of Klingelfuss [see Abstract No. 1048 (1903)] and the blue or long gap discharge is evident. When the secondary is on open circuit, so that no discharge takes place, both primary and secondary current curves show the effect of the reactions of the natural oscillations in one circuit upon the other, the curves in both cases being compounded of two oscillations. These oscillations in the secondary occur on the cessation of the spark whenever the resistance is sufficiently great, and occur in the case of the blue or long spark. In the case of the discharge with "aureola," the current curve is of a logarithmic type with large damping, the only oscillations being those caused by the primary. A mathematical discussion then follows, in which the differential equations for the currents in the two circuits are obtained, and particular solutions for the above cases. The necessity for the coil being provided with an adjustable condenser for the obtaining of maximum effect is pointed out. S. G. S.

2070. *Duration of Afterglow produced by Electrodeless Discharge.* **C. C. Trowbridge.** (Phys. Rev. 23. pp. 279–307, Oct., 1906.)—A fuller investigation of the duration of the afterglow is made than in the previous paper [Abstract No. 751 (1906)], the relation between pressure and duration of afterglow for different potential gradients in the discharge, and different frequencies, being found. The vessel employed consists of two cylindrical bulbs united by a tube and wide-bore stopcock. The upper bulb is connected with the pump, and in it the discharge takes place, the glow diffusing into the lower one; its rapidity of disappearance is there observed. The afterglow is observed visually; the walls of the room and the apparatus being blackened, and the illumination being always feeble, no after-images are produced. With potential gradient of 45 volts per cm. and period $9{\cdot}78 \times 10^{-7}$ sec. a minimum in the time of afterglow occurs at a pressure of 0·3 mm. (about 8 sec.), and on reducing the pressure to 0·09 mm. there is a maximum (about 32 sec.) beyond which the duration falls rapidly. The curves indicate that there is always this minimum, but that it occurs at higher pressures as the potential gradient is raised, and it frequently happens that at this critical pressure the afterglow is not produced at all; also this critical pressure is that at which the white discharge begins; when it is pink no afterglow occurs, but as it becomes whiter the afterglow is more definite and of longer duration. When the discharge takes place in gas at the temperature of liquid air, the intensity and duration of the afterglow are very much diminished, but if the discharge takes place at atmospheric temperature and the glow be allowed to diffuse into a vessel at the temperature of liquid air, the curve of duration is similar to that obtained at ordinary temperatures. Conditions such as a succession of discharges, change of the gas with time, diminution of pressure while the gas is glowing, and gradual reduction in quantity of water vapour in the gas, all tend to increase the duration of the afterglow. An analogy between the afterglow in the case of a meteor and that in the case of the electrodeless discharge is indicated. The evidence is not yet sufficient on which to base a theory of the afterglow. S. G. S.

2071. *Resistance of Solenoids for Variable Currents.* **G. Picciati.** (N. Cimento, 11. pp. 351–374, May and June, 1906.)—The resistance of a solenoid of circular wire of small radius wound upon a cylinder of large diam. is calculated, a general expression being obtained which, although complicated, takes simple forms in the cases of currents of low, medium, and high frequencies. The further assumptions are made that the magnetic field external to the solenoid is zero, and inside it is parallel to the axis; and then w/w_0, the ratio of the actual resistance to that of the wire when straight, is calculated. The calculated results indicate a higher value for w/w_0 than that found by Wien and by A. Battelli. [See Abstract No. 1899 (1906).]

S. G. S.

2072. *Theory of Directed Wireless Telegraphy.* **J. A. Fleming.** (Roy. Soc., Proc. Ser. A. 78. pp. 1–8, July 21, 1906. Electrician, 57. pp. 455–457, July 6, 1906. Ecl. Electr. 48. pp. 270–278, Aug. 18, 1906.)—The author shows that the horizontal aerial wire used by Marconi and others as a means of directing the radiation may be represented as a combination of three elementary Hertz oscillators. In order to obtain the lines of force at any moment it is therefore only necessary to superpose the fields due to the three oscillators. The following equations for the scalar and vector potentials are obtained for parts of the field at a distance from the oscillator:—

$$V = -\frac{\phi}{k}\frac{d\Pi}{dz} + \frac{1}{2}\frac{\phi}{k}\frac{d^2\Pi}{dy\,dz}\delta y - \frac{\phi'}{k}\frac{d^2\Pi}{dz\,dy}\delta z \quad \ldots\ldots\ldots\ldots\ldots\ldots (8)$$

$$F = O\ ;\ G' = \phi'\frac{d^2\Pi}{dz\,dt}\delta z\ ;\ H = \phi\frac{d\Pi}{dt} - \frac{1}{2}\phi\frac{d^2\Pi}{dy\,dt}\delta y \quad \ldots\ldots\ldots (9)$$

where ϕ is the electric moment of the oscillator; k is the dielectric constant of the medium; $\phi'\delta z = \phi\delta y$; $\Pi = [\sin\,(mr - nt)]/r$; $n/2\pi =$ frequency and $2\pi/m =$ wave-length.

From these equations the author deduces E, the amplitude of the electric force perpendicular to the radius vector and to the equatorial plane, and H the amplitude of the magnetic force perpendicular to the radius vector and in the equatorial plane. These have the values—

$$E = \frac{1}{kr^3}\left[\left\{\phi(m^2r^2 - 1) + \frac{3}{2}\frac{M}{v}\frac{\cos\theta}{mr}\right\}^2 + \left\{\phi mr - \frac{M}{2v}(m^2r^2 + 3)\cos\theta\right\}^2\right]^{1/2},$$

$$H = \frac{1}{r_3}\left[(\phi m^2r^2v)^2 + (\phi vmr - \frac{M}{2}m^2r^2\cos\theta)^2\right]^{1/2},$$

where $M =$ Magnetic moment of the bent oscillator, so that $\phi\delta y = \phi'\delta z = M/n$ and $v = n/m$. An examination of the maxima and minima of these expressions shows that the theory agrees with the experimental observations made by Marconi [see Abstract No. 655B (1906)].

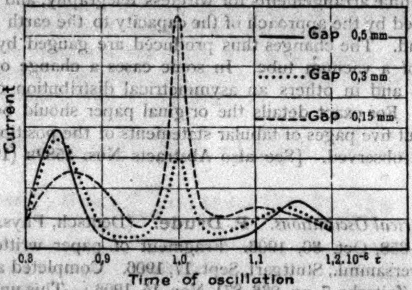
J. E.-M.

2073. *Vacuum Tubes as Detectors of Electrical Oscillations.* **C. Tissot.** (Écl. Électr. 48. p. 354, Sept. 1, 1906. Abstract of paper read before the Soc. franç. de Physique.)—The author has previously shown that though the effective voltage at the top of a tuned receiving aerial at 1 km. from the transmitter may be 4–5 volts, the maximum voltage can be as high as 600–800 volts [see Abstract No. 756 (1906)]; he has confirmed this by placing a vacuum tube at the summit of an aerial, when it was easily caused to glow. The tube can be substituted for the coherer and luminescence obtained also in this case, but greater sensitiveness is obtained by raising the electrodes to nearly the critical voltage of discharge, by means of an auxiliary battery. Quantitative readings may be obtained by observing the conductivity of the gas in the tube, in place of the luminescence. For this purpose the tube is provided with two auxiliary electrodes of large surface, which are included in the circuit of a source of continuous current and a galvanometer. The current through the galvanometer, upon oscillations passing, is a complex function of the p.d. between the main electrodes. The effect obtained is different according as it is used without auxiliary field or with such field. In the first case the behaviour is that of an autodecoherer, while in the second case the tube can be made to act as a rectifier. [See also de Forest, Abstract No. 1475B (1906).] L. H. W.

2074. *Influence of Capacity's Approach to Earth or other Conductor.* **P. Drude.** (Ann. d. Physik, 21. 1. pp. 123–130, Oct. 25, 1906.)—This paper deals with antennæ arrangements for wireless telegraphy, and the change in frequency caused by the approach of the capacity to the earth or a wire with a plate at its end. The changes thus produced are gauged by the strong or feeble action of a vacuum tube. In some cases a change of 7½ per cent. was produced, and in others an asymmetrical distribution of the electric force resulted. For exact details the original paper should be consulted, as it contains about five pages of tabular statements of the positions of the plate and the effects observed. [See also Abstracts Nos. 1589B (1905) and 655B (1906).] E. H. B.

2075. *Electrical Oscillations.* **P. Drude.** (Deutsch. Phys. Gesell., Verh. 8. 20. pp. 346–358, Oct. 30, 1906. Fragment of paper written for the 78 Naturforscherversamml., Stuttgart, Sept. 17, 1906. Completed and read by F. Kiebitz. Phys. Zeitschr. 7. pp. 866–871, Nov. 15, 1906.)—This unfinished paper of the author's gives a review of the different investigations dealing with electrical oscillations carried out by him, and the chief results. These have mostly been dealt with separately. A few experiments are mentioned which the author had partly completed, but not published. The final results of the author's investigations on wireless telegraphy are given in his own words. These are well rendered by saying that the best method of wireless telegraphy is held to be that in which (1) magnetic coupling is employed; (2) transmitter and receiver are exactly similar; (3) a magnetic detector is employed as receiver, in which the iron core is placed round the winding which leads to the capacity. This iron core should respond to the *integrated* as opposed to the maximum effect; and under these circumstances sharp tuning between transmitter and receiver can easiest be effected. L. H. W.

2076. *Intensity of the Two Waves in Coupled Transmitters.* **M. Wien.** (Deutsch. Phys. Gesell., Verh. 8. 20. pp. 486–489, Oct. 30, 1906. Paper read before the 78 Naturforscherversamml., Stuttgart, Sept. 18, 1906.)—Slaby has previously investigated whether it is possible, by the putting out of resonance (Verstimmung) of the condenser circuit, to strengthen the one component wave at the expense of the other [Abstract No. 261B (1906)]. The author here examines the question further. Employing Zenneck's modification of Bjerknes' resonance method ["Elektromagnetische Schwingungen," p. 606] the author obtains results in accordance with theory, which postulates, for this effect to be obtained, that the damping (δ_1) of the condenser circuit must be either greater or less than that of the aerial (δ_2). The greater the difference in the dampings ($\delta_1-\delta_2$), the greater must be the "untuning" at which the max. effect is obtained at the receiver, and the higher is this maximum. In wireless telegraphy the aerial system is more strongly damped than the condenser circuit, and therefore by "untuning" a greater effect by about 20 per cent. should be obtainable, and at the same time the damping be reduced. In all the experiments the higher-frequency wave was benefited, and this results from the fact that here, in opposition to theory, according to which the higher-frequency wave should be the more highly damped, this wave is *less* damped than the lower-frequency one. The explanation is held to lie in the unequal division of the energy between the two components in the spark-gap. The small inherent damping of the higher-frequency wave can be still further reduced by means of "untuning," and in this way waves can be obtained which are suitable for simultaneous [selective (?)] telegraphy. Reducing the spark-length, which increases the damping of the lower-frequency wave, to less than 0·5 mm., partial discharges are obtained, and at smaller distances hissing discharges. At this point a third maximum appears in coupled transmitters, between the maxima of the two normal component waves. The damping of this third oscillation must be very small, from the shape of the curve (line of dashes in Fig.). The origin of this wave is held to be explained by the rapid recovery of resistance of short gaps, so that the oscillations of the lower frequency soon disappear. The oscillations in the higher-frequency system then persist as a separate uncoupled system with its own proper frequency and damping. It is thought that a method of producing very slightly damped oscillations may be arrived at in this way. L. H. W.



ELECTRICAL PROPERTIES AND INSTRUMENTS.

2077. *Behaviour of Selenium towards Light and Temperature.* III. **R. Marc.** (Zeitschr. Anorg. Chem. 50. 4. pp. 446–464, Sept. 21, 1906. Mineralog.-Geolog. Inst. d. Univ., Jena.)—The author has found that the black crystalline modification (A) of selenium is a non-conductor of electricity, and that its apparent conductivity is due to admixture with selenium dioxide. The establishment of the equilibrium between the A and B forms of selenium is greatly accelerated by the presence of metallic catalytic agents, especially silver and platinum; even so small an amount of silver as 0·03 per cent. is effective. With the assistance of catalytic agents the curve of equilibrium could be studied throughout, and was found to show a maximum point at about 100°. [See also Abstract No. 1111 (1906).] D. H. J.

2078. *Deviations from Ohm's Law, the Rectifier and Detectors of Electrical Oscillations.* **H. Brandes.** (Elektrotechn. Zeitschr. 27. pp. 1015–1017, Nov. 1, 1906.)—The author shows that, in general, conductors or combinations of conductors which do not follow Ohm's law are capable of acting as detectors of electrical oscillations, owing to their rectifying effect. A verdict as to whether such an arrangement is more or less suitable for this purpose can be derived from the continuous-current characteristic (voltage-current curve). If this characteristic be symmetrical in the first and third quadrants, such an arrangement can be used as a detector, the oscillations being superposed on a suitable continuous current. If the characteristic be asymmetric, the arrangement can be used as a detector without an external e.m.f., although a suitable auxiliary e.m.f., on which the oscillations are superposed, often increases the effect. These conclusions are arrived at as a result of considering the action of Braun's pyrolusite, Holtz's valve cell, the electrolytic detector, the Wehnelt oxykathode tube, the vacuum tube, the conductivity of flames, and Ferrié's so-called electrolytic detector without polarising e.m.f. L. H. W.

2079. *Comparison of Resistances.* **F. E. Smith.** (Electrician, 57. pp. 976-978, Oct. 5, and pp. 1009–1011, Oct. 12, 1906. Appendix to Report of British Assoc. Committee on Practical Standards for Electrical Measurements.) [For Report see Abstract No. 2096 (1906).]—A brief description is given of the various methods of comparing standards as used at the National Physical Laboratory, and mention is made of their relative sensitivities. The methods discussed are those of: (1) Wheatstone, (2) Carey Foster, (3) Kelvin (double bridge), (4) Matthiessen and Hockin, (5) Rayleigh, (6) Housman, (7) Campbell, (8) Kohlrausch (differential galvanometer), and (9) the potentiometer method. The sensitivities of Nos. (3), (8), (1), (9), as practically used in comparing mercury standards, are $0{\cdot}025i\Delta$, $0{\cdot}098i\Delta$, $0{\cdot}35i\Delta$, $0{\cdot}85i\Delta$ respectively, where i is the current through the standard and $\Delta = \delta P/P$, P being the resistance of the standard. The theory of the double bridge is worked out as an example of the application of the law that, in any network of conductors the current in one arm due to an e.m.f. in another arm is equal to the current in the latter when an equal e.m.f. is placed in the former. J. D. C.

2080. *Moving-coil Galvanometers.* **W. Jaeger.** (Ann. d. Physik, 21. 1. pp. 64–86, Oct. 25, 1906.)—A more complete discussion is given than in the author's previous paper [Abstract No. 408 (1905)]. The conclusion is arrived at that the most useful condition for a moving-coil galvanometer is that of critical damping, that is, the motion is on the boundary between the periodic and the aperiodic condition. This agrees with the conclusion of W. P. White [Abstract No. 181 (1905)]. In the critical condition the equation of motion becomes $\partial^2\phi/\partial\delta^2 + 2\partial\phi/\partial\delta + \phi = f(\delta)$, where $\delta = \pi t/\tau = \sqrt{K/D}$, τ is the time of a half swing, K the moment of inertia of the moving part, and D the controlling couple. When $f(\delta) = 0$ the solution is $\phi = (A + B\delta)e^{-\theta}$, and when $f(\delta) = V\delta$, $\phi = V[\delta - 2 + (\delta + 2)e^{-\delta}]$. The sensitiveness of the galvanometer is expressed in two ways; S is the deflection in radians when c.g.s. unit of current flows in the coil, and P the deflection in radians when c.g.s. unit of p.d. is maintained between the terminals. Then, $S = \sqrt{2Tr/D}\,.\,\alpha/\beta$ and $P = \sqrt{2T/rD}\,.\,\alpha\,.\,\beta$, where $T = T/r = \sqrt{K/D}$, r is the resistance in the external circuit, and α and β are given by the equations, $\alpha = \sqrt{1 - \sqrt{\lambda_0^2/(\pi^2 + \lambda_0^2)}}$, ($\lambda_0$ = log. dec. on open circuit) and $\beta = (1 + r_k/r)^{-\frac{1}{2}}$, ($r_k$ = res. of galvanometer). The effect of varying these quantities is discussed, and the sensitiveness of these instruments of Siemens and Halske found, and also the comparison of the moving-coil with the suspended-needle galvanometer is made. It is also pointed out that the useful sensitiveness is often limited by the fact that the instrument is liable to disturbance from outside causes, and that when this is the case it is useless to perfect the optical arrangements for observing the deflection. S. G. S.

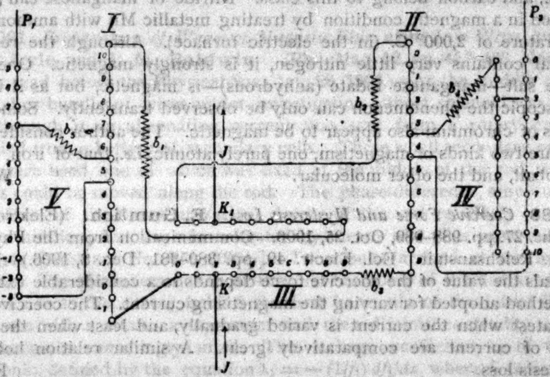
2081. *Moving-coil Galvanometer.* **W. P. White.** (Phys. Rev. 23. pp. 382-398, Nov., 1906.)—Everyday problems of the moving-coil galvanometer are discussed, the energy equation, the relation between moment of inertia, moment of torsion, and periodic time, and the condition for critical damping being dealt with first. Four points of excellence are enumerated; they are: (1) Steadiness of the coil, (2) smallness of the controlling force, (3) ability to secure short period, and (4) constancy of zero. Weak field magnets are not favoured, it being shown that increase in field strength when used to shorten the period diminishes the detrimental effect due to the magnetic attraction of the coil. The author believes that except where extreme sensibility is needed, the periods of many instruments are too long and the magnets too weak. Also the advantages of light coils are often insufficiently appreciated. A table is given showing the sensibility attained and the coil resistance needed for various periods and resistances, a field strength of 1,000 lines being assumed. Easily attainable values of the moments of inertia and torsion are chosen. [See also Abstract No. 181 (1905).] F. E. S.

2082. *Ballistic Galvanometer with Moving Coil.* **A. Zeleny.** (Phys. Rev. 23. pp. 399-421, Nov., 1906.)—The object of this paper is to show how those difficulties are best overcome which are ordinarily associated with this instrument when used for work of high precision. It is shown that the constant is best determined by comparison with a known one of nearly equal magnitude, the two throws being obtained in immediate succession. In order to avoid a set in the fibre the throws should always be taken in the same direction, and on the return of the coil its motion should be stopped before it crosses the null point. Whenever possible the galvanometer should be used on open circuit; it is then more sensitive and the quantities more nearly proportional to the throws. When, however, the circuit is changed from a closed to an open one, or the reverse, the thermoelectric effects must be eliminated or a correction applied. The mica condenser (free charge capacity) is recommended as by far the most convenient working standard for the comparison of electrical quantities. F. E. S.

2083. *Standard Current Meter.* (Electrical World, 48. p. 798, Oct. 27, 1906.)—This is a simple form of current-measuring instrument designed by C. Hering for use as a secondary standard. It consists of two coils placed one above the other, the upper coil being fixed and the lower one movable. The latter is held up against the under side of the fixed coil by the attraction due to the currents, the arrangements being such that when the current is less than a certain definite value, the lower coil drops away. The instrument is essentially one for indicating a single chosen value of current. F. E. S.

2084. *New Selenium Cell.* **M. Reinganum.** (Phys. Zeitschr. 7. pp. 786-787; Discussion, p. 787, Nov. 1, 1906. Paper read before the 78 Naturforscherversamml., Stuttgart, Sept. 16-22, 1906. Electrician, 58. pp. 332-333, Dec. 14, 1906. Translation.)—The selenium cell described by v. Uljanin (Wied. Ann. 34, 1888), consisting of a selenium film mounted between two platinised glass plates, suffers under the disadvantage of a high resistance. This is overcome by the author by covering a piece of Pt-foil with a selenium film and using it as kathode in a cell containing sulphurous acid or other electrolyte, the anode being a simple Pt electrode. When the kathode is illuminated by a Nernst lamp at a distance of 80 cm., an e.m.f. of about 0·2 volt is produced. The covering of the platinum is effected by moistening it with water and exposing it to the dark-green vapour of melted selenium. The latter is contained in a horizontal test tube heated with a Bunsen burner. A thin consistent coating is precipitated which may be converted into conducting selenium by heating it to 180° C. When the electrode is illuminated intermittently and the cell is inserted in a telephone circuit a sound is heard. The sound is considerably strengthened when a battery with an e.m.f. of about 0·6 volt is introduced into the telephone circuit in such a manner that the selenium electrode is the kathode. A selenium surface 1 cm. square gives about 0·05 millivolt. A low e.m.f. must be used in the circuit to prevent the selenium dissolving. The new cell probably has a very short period of recovery. **E. E. F.**

2085. *Potentiometers without Thermoelectric Errors.* **H. Diesselhorst.** (Zeitschr. Instrumentenk. 26. pp. 297–305, Oct., 1906. Communication from the Physikal.-Techn. Reichsanstalt.)—Various types of potentiometer by Hausrath and others are described, in which the thermoelectric forces at the potential points are avoided, leading up to that of the author, which is shown



in the Fig. This is a 5-dial instrument, in which the dials numbered I. to V. enable the p.d. between the potential points P_1, P_2 to be adjusted in five successively diminishing steps. The current is led into and out of the potentiometer by the contact arms K and K_1, which can be moved together in the same direction over their respective contacts. The resistances between these contacts are equal, and it will be observed that this operation does not affect the total resistance in either of the two parallel paths along which the current J divides, but that it increases (or decreases) the p.d. between P_1 and P_2. It is only necessary to take precautions to avoid the thermoelectric forces in the contacts of the dials for fine adjustment, and, as will be seen on consideration of the Fig., this is aimed at in the arrangement of the dials III. IV., and V. The method of subdivision used in dials IV. and V. is described in Abstract No. 1485 (1906). **J. D. C.**

ALTERNATING CURRENTS AND MAGNETISM.

2086. *Phase-splitting Device.* **E. Müllendorff.** (Elektrotechn. Zeitschr. 27. pp. 1066–1067, Nov. 15, 1906.)—The author shows that between two parallel circuits having resistances r_1, r_2, and inductances L_1, L_2, respectively, a phase-difference of exactly 90° may be obtained by arranging the circuits so that they have a mutual inductance M given by the equation—

$$M = \tfrac{1}{2}(L_1 + L_2) \mp \sqrt{(L_1 - L_2)^2 (r_1 r_2 / p^2)},$$

where $p = 2\pi \times$ frequency. A. H.

2087. *Magnetic Compounds of Non-magnetic Elements.* **E. Wedekind.** (Deutsch. Phys. Gesell., Verh. 8. 20. pp. 412–416, Oct. 30, 1906. Zeitschr. Elektrochem. 12. pp. 810–811, Nov. 2, 1906. Abstract. Paper read before the 78 Naturforscherversamml., Stuttgart, Sept. 16–22, 1906.)—Describes magnetic compounds of manganese other than the Heusler alloys, the second components being such bodies as boron, antimony, phosphorus, &c., which are all non-magnetic. It is remarkable that these compounds have considerable power of retaining magnetisation. A compound of Mn with Bi is strongly magnetic, although Bi itself is strongly diamagnetic. Other compounds of Mn, although ordinarily not magnetic, become so after exposure to very high temperatures; compounds of Mn with sulphur, arsenic, and carbon belong to this class. Nitride of manganese can also be obtained in a magnetic condition by treating metallic Mn with ammonia at a temperature of 2,000° C. (in the electric furnace). Although the resulting material contains very little nitrogen, it is strongly magnetic. One manganese salt—manganese iodate (anhydrous)—is magnetic, but as it is very hygroscopic the phenomenon can only be observed transiently. Some compounds of chromium also appear to be magnetic. The author considers that there are two kinds of magnetism, one purely atomic, *i.e.*, that of iron, nickel, and cobalt, and the other molecular. W. Ros.

2088. *Coercive Force and Hysteresis Loss.* **E. Gumlich.** (Elektrotechn. Zeitschr. 27. pp. 988–989, Oct. 25, 1906. Communication from the Physikal.-Techn. Reichsanstalt. Écl. Électr. 49. pp. 380–381, Dec. 8, 1906.)—In soft materials the value of the coercive force depends to a considerable extent on the method adopted for varying the magnetising current. The coercive force is greatest when the current is varied gradually, and least when the increments of current are comparatively great. A similar relation holds for hysteresis loss. F. E. S.

2089. *Magnetic Properties of Electrolytic Iron.* (Amer. Inst. Elect. Engin., Proc. 25. pp. 666–671, Sept., 1906. Discussion.) [For C. F. Burgess and A. H. Taylor's paper see Abstract No. 1782 (1906).]—**C. P. Steinmetz** gives particulars of some experiments with an iron amalgam containing about 11 per cent. of electrolytic iron. The magnetic analysis showed an almost constant permeability of 2, and a high hysteresis loss. Attention is also drawn to the great change which is taking place in our conception of magnetism, and to the large increase in the known number of magnetic alloys. Manganese appears to be a magnetic metal, but is non-magnetic when free. If the metal by itself could be made to exhibit the same permeability as it has in alloy, it would be several times more magnetic than iron, and have a magnetic saturation several times higher. It is not impossible that there might be found alloys of metals which have permeabilities higher than iron. **C. F. Burgess** states that it has not been proved conclusively whether hydrogen is held physically or chemically in electrodeposited iron, and it is not unreasonable to suppose that it may exist in both states. The ratio of the magnetic cycles for heated and unheated electrolytic iron is approximately the same for low fields as it is for high ones. **R. A. Fessenden** points out that the methods described for the measurement of permeability [see Abstract No. 1783 (1906)] are entirely inadequate to give accurate results. [For properties of electrolytic iron see also Leick (Wied. Ann. 58. pp. 691–715, 1896); Phys. Soc. Abstracts No. 717, 1896).] F. E. S.

2090. *Use of Chilled Cast-Iron for Permanent Magnets.* **A. Campbell.** (Phil. Mag. 12. pp. 468–472, Nov., 1906. Paper read before the Physical Soc., Jan. 26, 1906. Electrician, 58. p. 333, Dec. 14, 1906.)—The research described in this paper was undertaken with the object of confirming the conclusions arrived at by B. O. Peirce [Abstract No. 1288 (1905)], and of finding an easy method of chilling cast-iron. The material experimented on was of ordinary commercial quality. It was first heated in a gas muffle furnace to 1,000° C., the temperature being measured by a thermo-junction in the usual way, and was then plunged into cold water. The coercivity was found to be nearly equal to that of ordinary magnet steel. Tests carried out on two rings, one of which was of much larger cross-section than the other, showed that the method of chilling could be relied upon as effective even in the case of large magnets. A. H.

2091. *Propagation of Waves of Magnetic Flux along Iron Wires and Rods.* **T. R. Lyle** and **J. M. Baldwin.** (Phil. Mag. 12. pp. 433–468, Nov., 1906. Paper read before the Physical Soc., Jan. 26, 1906.)—At the middle point of the rod or bundle of wires under investigation a short solenoid was placed, and through it an alternating current was sent from a rotary converter supplied from a battery of secondary cells. Three small secondary or search coils were used, one of which was fixed at the middle of the rod, while the others could be moved along the rod. The phase-difference, amplitude, and wave-form of the fluxes at various points of the rod relatively to the flux at the middle point were investigated by means of Lyle's wave-tracer and analyser [Abstract No. 75B (1904)]. The results arrived at are briefly as follows: The phase retardation of the first harmonic of the flux at any point distant x from the centre, behind the first harmonic of the initial flux, first increases with x, attains a maximum and then diminishes steadily until the flux becomes vanishingly small. The leakage coefficient λ_1 of the first harmonic, defined by the equation $\lambda_1 = -(1/f_1)\, df_1/dx$, where f_1 is the amplitude of the first harmonic, first increases with x, attains a maximum, and then steadily decreases. The distances from the middle of the rod or bundle at which the phase retardation and leakage coefficient reach their maxima are equal (or very nearly so); this distance is termed by the authors, the critical distance. The above results are not in agreement with those of previous investigators, who used less sensitive methods, and so were only able to obtain observations within the critical distance, but not beyond it [Abstract No. 3264 (1904)]. As the flux wave advances along the bundle of wires, its wave-form changes, the wave becoming flatter as x increases until the critical point is reached, when its flatness is a maximum; beyond this as x increases the flatness diminishes. Eddy currents diminish the critical distance and increase the leakage coefficient, and an increase of frequency produces similar effects. A. H.

2092. *Observations with a Braun Tube.* **F. Piola.** (Accad. Lincei, Atti, 15. pp. 222–231, Aug. 19, 1906.)—The effect of superimposing a rapidly alternating magnetic field upon the slowly alternating field to which a bundle of iron wires is subjected, has been investigated by the author, the strength of magnetic field and intensity of magnetisation being indicated by a Braun tube [see Abstract No. 582 (1906)]; in the present paper the method of applying the superimposed field is modified. The alternating current from a 100-volt supply passes through the primary of an induction coil, and in series with the secondary is a resistance, a coil with movable iron core, some turns of wire wound upon the specimen being studied, a condenser and a spark-gap. Thus a rapidly alternating field is applied to the specimen every time a spark passes, and the frequency, amplitude, and damping of the field can be varied at will. When the spark passes once every half period of the primary field the resulting magnetisation curve exhibits a discontinuity, each time the spark takes place, of such a kind that the points immediately preceding and following are separated by a line parallel to the magnetisation axis, the separation depending upon the phase at the time of the spark, the direction, amplitude, and damping of the superimposed field. By closely examining the figure upon the fluorescent screen it is found that the curve is not really discontinuous, the points being joined by a typical magnetisation curve of the damped type. The effects of more sparks than one per half period, and of applying the rapidly oscillating field alone, are also studied.

S. G. S.

2093. *Action of Minute Telephonic Currents upon Steel in a Rotating Field.* **R. Arnò.** (N. Cimento, 11. pp. 278–280; Discussion, p. 280, May and June, 1906. Abstract of paper read before the Soc. Italiana di Fisica, April 28, 1906.)—The author has previously shown that with low-frequency alternating and interrupted currents the increase of hysteresis [loss] occasioned by the action of these currents is greater the higher the frequency or number of interruptions. An increase being also obtainable with high-frequency oscillations [Walter and Ewing], it would be expected that the steel is also sensitive to currents of intermediate frequencies. It is here shown that the sensitiveness to telephonic currents is very considerable, a large galvanometer deflection being obtained on simply speaking into an ordinary Bell telephone receiver connected to the winding embracing the steel. The general effect is that corresponding to an increase of hysteresis [loss], but it is possible to arrange matters so that a decrease is obtainable. Further, under certain conditions it can be arranged that, other conditions remaining unaltered, an increase or decrease can be obtained by simply varying the intensity and frequency of the telephonic current, that is to say by varying the nature of the sound emitted in front of the telephone [probably at the critical field]. In the *discussion*, **Piola** said that the author's results with rotating hysteresis were in agreement with his own experiments on static hysteresis observed with the Braun tube. This agreement arises from the fact that the torque in the author's apparatus does not depend [as the author has maintained] solely on the hysteresis [see Abstract No. 2289 (1905)], but also on the mean permeability of the rotor (the suspended steel cylinder). L. H. W.

REFERENCES.

2094. *Magnetic Measurements in Siberia.* **D. Smirnow.** (Terrestrial Magnetism, 11. pp. 97–101, June, 1906.)

2095. *Influence of Earth's Motion on Electromagnetic Phenomena.* **J. Farkas.** (Phys. Zeitschr. 7. pp. 654–657, Oct. 1, 1906.)—Incited by recent remarks of Kaufmann the author here endeavours to frame a system of equations based on Lorentz's theory and dealing with the theory of the celebrated Michelson interference experiments. E. H. B.

2096. *Report to British Association of Committee on Practical Standards for Electrical Measurements.* (Electrician, 57. pp. 706–707, Aug. 17, 1906. Abstract. Elect. Rev., N.Y. 49. p. 375, Sept. 8, 1906.)—Deals with the work on this subject done by the Conference at Charlottenburg [see Abstract No. 744 (1906)]. J. D. C.

2097. *Present State of Knowledge of the Electric Arc.* **C. D. Child.** (Jahrbuch d. Radioakt. u. Elektrotonik, 3. 2. pp. 189–226, July 24, 1906. Translation from the English.)

2098. *Measurement of Disruptive Potentials.* **Tits.** (Annal. Soc. Sci. de Bruxelles, 30. 3 and 4. pp. 190–194, 1905–1906.)—For the measurement of the p.d. at which discharge takes place a second spark-gap with spherical terminals is employed in parallel with the main gap [see Abstract No. 1103 (1906)]. This auxiliary gap is of the micrometric type, and is previously calibrated. The calibration and use of this arrangement are described. S. G. S.

2099. *Increasing the Constancy of Battery Currents.* **W. P. White.** (Phys. Rev. 23. pp. 447–448, Nov., 1906.)—It is well known that a battery of accumulators can be used in parallel with a dynamo to steady the voltage. The same principle can be utilised to make primary or secondary cells supply a steadier current. An adjustable resistance is put in series with the row of cells having the higher voltage. The equations are given. A. R.

2100. *Use of Electrolytic Detector in Kohlrausch Bridge Methods.* **H. Armagnat.** (Journ. de Physique, 5. pp. 748–762, Nov., 1906. Paper read before the Soc. Franç. de Physique, April 5, 1906.)—The Ferrié-Carpentier apparatus for carrying out the method of measurement described by Nernst and v. Lerch [Abstract No. 1517 (1904)] is dealt with, to whose work, however, no reference is made. The detector is also erroneously attributed to Ferrié [see Abstract No. 1775 (1905)]. L. H. W.

2101. *Multiple Resonance.* **A. Garbasso.** (Ann. d. Physik, 20. 4. pp. 846–848, July 20, 1906. Phys. Inst. d. k. Univ., Genua.)—A brief history of the contributions of the various physicists to this subject with quotations from letters received by the author from Hertz on the subject. [See also Abstracts Nos. 570, 936, and 1431 (1906).] E. H. B.

2102. *Observations of Alternating-current Rectifiers.* **A. C. Jolley.** (Electrician, 57. pp. 998–1000, Oct. 12, 1906.)—Experimental results with a 5-amp. Nodon valve.

2103. *Efficiency Meter for Glow-lamps.* **E. P. Hyde** and **H. B. Brooks.** (Bureau of Standards, Bull. 2. pp. 145–160, June, 1906.)—A full description of the apparatus outlined in Abstract No. 1218 (1906).

2104. *Simple Method for the Study of the Movements of Metallic Vapours in the Oscillating Spark.* **G. A. Hemsalech.** (Comptes Rendus, 142. pp. 1511–1514, June 25, 1906.)—An extension of a previous investigation [see Abstract No. 519 (1906)]. The author finds that the metallic vapour is projected from the positive electrode. E. C. C. B.

CHEMICAL PHYSICS AND ELECTRO-CHEMISTRY.

2105. *Separation of Radio-thorium from Thorium Salts.* **G. A. Blanc** and **O. Angelucci.** (Accad. Lincei, Atti, 15. pp. 90–94, July 15, 1906.)—The separation depends on the fact that barium sulphate, when precipitated in a solution of thorium nitrate, carries down with it the radio-thorium. The activity of thorium salts is due to the presence of traces of this radio-thorium. D. H. J.

2106. *New Methods of separating Uranium X from Uranium.* **R. B. Moore** and **H. Schlundt.** (Phil. Mag. 12. pp. 393–396, Oct., 1906.)—The authors show that Ur X may be separated from uranium by means of acetone, in which the Ur X is insoluble, and that this method of separation is more satisfactory than those already in use. Methyl, ethyl, and amyl alcohols, methyl and ethyl acetates and acetoacetic ether may be used instead of acetone. Ur X was found to emit not only β- but also α-rays. D. H. J.

2107. *On an Allotropic Form of Arsenic. The Possible Existence of Unknown Radiations.* **W. Thomson.** (Manchester Lit. and Phil. Soc., Mem. 50. 12. pp. 1–9, Aug. 27, 1906. Chem. News, 94. pp. 156–157, Sept. 28, and pp. 166–167, Oct. 5, 1906.)—The author draws attention to the sensitive allotropic form of arsenic, obtained by subliming the latter and then rapidly condensing it in vacuo or in presence of an inert gas; the arsenic condenses as a white film which rapidly becomes black. It is suggested that physicists may find some means of preserving the white form, and that the change from white to black may be due to unknown radiations, which may thus be detected. The subject might repay attention in view of recent work on radiations. D. H. J.

2108. *Conductivities of Mixtures of Sulphuric Acid with Sulphates.* **Hollard.** (Soc. Franç. Phys., Bull. 2. pp. 128–141, 1906. Journ. de Physique, 5. pp. 654–667, Oct., 1906.) — Tables are given of the conductivities of mixtures of sulphuric acid with the sulphates of sodium, of magnesium, of zinc, of copper, and of ammonium. With the exception of the mixtures with ammonium sulphate, the results are very similar for all the mixtures; the addition of the sulphate to the sulphuric acid diminishes the conductivity, and hence the number of ions, instead of increasing it. There is, therefore, obviously a formation of complexes such as HSO_4. D. H. J.

2109. *Synthesis of Amethyst Quartz. Colouring of Precious Stones by Radioactive Influences.* **Berthelot.** (Comptes Rendus, 143. pp. 477–488, Oct. 8, 1906.)—Natural amethyst quartz, which probably owes its violet colour to the presence of Mn., was decolourised by heating to 300° and did not regain its colour by keeping for some months or by exposing to sunlight. The colourless crystals were sealed into a glass tube and enclosed in a larger tube with a sealed tube of radium chloride, the two sealed tubes being separated by filter-paper; at the end of about 6 weeks the colour was found to be reappearing. The same colour was developed in a tube of fused quartz, which was also stated to contain a trace of Mn. Similar results were observed with a violet fluorite from Weardale, although the re-colouring proceeded more slowly. The colouring of natural amethysts is attributed to radiation from natural radio-active substances. Glass exposed to the radiation becomes black on the outside, but the inner parts of the glass show an intense violet-blue colouration, possibly again owing to the oxidation of manganese salts. The suggestion is made that the oxygen may penetrate from the outside like carbon in the cementation of steel. Smoky quartz, green fluorspar, and emerald, which owe their colour to organic matter, are decolourised by heat, giving off in some cases an odour of petroleum; but the action is non-reversible, and the colour cannot be restored by radiation. Red and blue alumina (corundum) retain their colour when heated; it is suggested that in this case the colour is not due to Mn. T. M. L.

2110. *Osmotic Pressures of Concentrated Aqueous Solutions.* **Berkeley** and **E. G. J. Hartley.** (Roy. Soc., Phil. Trans. 206. pp. 481–507, Oct. 22, 1906.)—Measurements were made of the osmotic pressures produced by sugar solutions separated from water by a membrane of copper ferrocyanide. Much difficulty was experienced in producing membranes through which no sugar could escape, but, in all, eighteen experiments were made in which this condition was fully satisfied. The sugars used were cane-sugar, dextrose, galactose, and mannite, the concentrations ranged from 100 to 750 gm. per litre, and the pressures produced from 13 to 130 atmos. The method of measurement was to determine the rate of flow in opposite directions when the pressure was a little greater or a little less than the osmotic pressure, and to calculate the equilibrium pressure for which the rate of flow would be zero. In all cases the observed osmotic pressure was greater than that calculated from the "gas-law" formula, but the curves showing the relationship between osmotic pressure and concentration, approach tangentially towards the straight lines which represent the calculated pressures, and it is clear that in dilute solutions there would be a close agreement between the observed and calculated values. The values obtained are somewhat higher than those recorded by Morse and Frazer, possibly owing to slight leakage of solution in the experiments of the latter. In confirmation of the validity of the method of working, the equilibrium pressure was determined between two cane-sugar solutions containing 750 and 540 gm. per litre. The equilibrium pressure between them was 66·0 atmos.; the difference between the osmotic pressures, observed against pure water, was 66·23 atmos. T. M. L.

2111. *New Silicide of Molybdenum.* **O. P. Watts.** (Amer. Electrochem. Soc., Trans. 9. pp. 105–107, 1906.)—The ingot obtained by heating in the electric furnace a mixture of molybdic acid, silica, boric anhydride, copper, and aluminium, with cryolite as a flux, and lime to diminish the violence of the reaction, yields, on extraction with nitric acid and dilute hydrofluoric acid, a mass of flat dark crystals with a metallic lustre, having the percentage composition Mo, 62·4; Si, 34·2; Fe, 1·1; B, 2·3, and a density at 20·5° C. of 6·31. From its behaviour with hot HF and boiling aqua regia the mass is believed to consist of iron silicide, molybdenum boride, and a new silicide of molybdenum, the residual Mo and Si corresponding closely with the formula $MoSi_2$. A similar ratio between the Si and Mo is also found in the product resulting from the reduction of a mixture of molybdenum and silica by CaC_2. W. H. Si.

2112. *Reduction of Metallic Sulphides.* **O. W. Brown.** (Amer. Electrochem. Soc., Trans. 9. pp. 109–115; Discussion, p. 116, 1906.)—Molybdenite is completely reduced to metal when smelted with lime and coke in the proportions required by the reaction $MoS_2 + 2CaO + 2C = Mo + 2CaS + 2CO$, employing a resistance furnace with a ½ in. × 4 in. carbon resistor, and a current of 275 amps. at 25 volts. An excess of lime is an advantage, but too much carbon causes formation of carbide which holds back some Mo. An attempt to reduce stibnite in a similar way and distil off the metal proved unsatisfactory, the slag remaining in the furnace containing 8·84 per cent. Sb. The method also proved unsuitable for the reduction of the sulphides of Cu, Fe, Ni, and Pb, in the case of the last a double sulphide PbSCaS being formed. W. H. Si.

2113. *Electric Smelting of Sulphidic Ores (Molybdenum) and of Mattes.* **C. Lehmer.** (Metallurgie, 3. pp. 549–555, Aug. 22, and pp. 596–602, Sept. 8, 1906. Communication from the Inst. f. Metallhüttenw. und Elektrometall. d. techn. Hochschule, Aachen.)—Smelting molybdenite (MoS_2) with aluminium, oxides or sulphides of metals, copper or nickel matte and also these mattes alone, together with lime and coal, the author obtains molybdenum and its alloys with 0·1 per cent. of sulphur. More than the theoretical amount of lime has to be added (from 1·33 to 1·5) to produce a metal fairly free from sulphur, unless an excess of carbon be applied. To keep the carbon percentage down the author makes the electrodes dip only into the slag; the hearth should not be one of the electrodes. Héroult furnaces, built up of blocks of marble or magnesite, are applied; the lining and slag must be basic lest silicon be reduced. The final slag should not contain any carbide. With coarse-grained materials (grains up to 10 mm. in size) the elimination of the sulphur is more difficult; fine powdering and briquetting of the material is often required owing to the want of homogeneity in the ores. Alloys of molybdenum with chromium, iron, nickel can easily be obtained from molybdenite and the oxides; in the case of manganese the sulphur is difficult to remove. A nickel matte yielded, with lime and carbon, a metal of 96·3 per cent. of Ni, 0·07 S, and 3·2 carbon. Charges of several kg. were applied. Molybdenite had been smelted in a tubular furnace by Guichard; Muthmann has reduced a mixture of the sulphide and lime to molybdenum, and prepared also iron alloys containing 95 per cent. Mo and 5 of Fe. H. B.

2114. *Manganese-Molybdenum Alloys.* **G. Arrivaut.** (Comptes Rendus, 143. pp. 464–465, Oct. 1, 1906.)—By reduction with powdered aluminium of mixtures of the oxides of Mn and Mo, alloys have been prepared containing up to 75 per cent. Mo. They are very hard, have a grained section with a silver-white appearance, and are non-magnetic. On treatment with alcoholic solution of acetic acid, or dilute HCl they yield definite steel-grey crystalline compounds, corresponding to the formulæ Mn_2Mo, MnMo, and $MnMo_2$, and having densities at 0° of 8·37, 8·60 and 8·70 respectively. [Errata, ibid. p. 564.] W. H. Si.

2115. *Pure Alloys of Tungsten and Manganese, and Preparation of Tungsten.* **G. Arrivaut.** (Comptes Rendus, 143. pp. 594–596, Oct. 22, 1906.)—By reducing with Al powder, mixtures of Mn_3O_4, MnO_2, WO_3, and WO_2, pure alloys of the two metals are readily obtained containing from 12 to 60 per cent. W. Alloys containing up to 25 per cent. W can also be prepared by heating the oxides in the Schloesing furnace in a current of H. Extraction of the coarsely-crushed alloys with HCl leaves a residue of pure tungsten. W. H. Si.

2116. *Platinum-Silver Alloys.* **J. F. Thompson** and **E. H. Miller.** (Amer. Chem. Soc., Journ. 28. pp. 1115–1132, Sept., 1906. Contribution No. 127 from the Havemeyer Lab. of Columbia Univ.)—Describes an analytical thermal, microscopic and electrical study of the Pt-Ag alloys, the following conclusions being arrived at: (1) The separation of Pt from Au, Ir, &c., in one operation by means of alloying with Ag and parting with nitric acid is impossible. (2) Analytical results on Pt-Ag alloys based on parting with concentrated sulphuric acid are incorrect for alloys containing 20 per cent. or more of Pt, unless correction is made for the undissolved Ag remaining with the Pt. (3) The existence of Pt-Ag compounds is probably the explanation of the irregular results obtained in parting with nitric acid. W. Ros.

2117. *Alloys in Atomic Proportions.* **W. Rubel.** (Ann. Gewerbe-u. Bauwesen, 59. p. 9, 1906. Chem. Zeit., 30. Rep. 248, 1906.)—The conductivity of copper smelted in a natural-draught furnace was 110 per cent. that of standard copper, whilst that of blast-smelted metal was 78 per cent. The tensile strength of an alloy of the composition Cu_3Fe_2NiAl was 82 kg. per sq. mm., elongation 8 per cent., structure showing two constituents with no eutectic. $Cu_3Fe_2Ni_2Al$ gave 75·7 kg. per sq. mm. tensile strength and 18 per cent. elongation in the quickly cooled state; the worked surface of this alloy had the colour of nickel; its resistance to chemicals was high. For alloys of this sort, which are intended to stand stress at temperatures up to 250° C., no Sn should be used, nor Mn for any which are to be exposed to high temperature. F. R.

2118. *Lead-Iron Sulphides.* **H. Weidmann.** (Metallurgie, 3. pp. 660–664, Oct. 8, 1906. Communication from the Aachener Inst. f. Metallhüttenw. und Elektrometallurgie.)—Mixtures of lead sulphide and iron sulphide in various proportions were melted together and the cooling-curves and microstructure of the resulting alloys were examined. From both lines of evidence the author concludes that PbS and FeS do not enter into combination with one another and are mutually insoluble in the solid state, a well-defined eutectic, containing 25·8 per cent. FeS, being formed. An attempt to form a compound containing a larger proportion of sulphur, such as would correspond with a formula like $PbSFe_2S_3$ gave negative results, which the author regards as proving that no such higher compounds exist. W. Ros.

2119. *Copper and Phosphorus.* **E. Heyn** and **O. Bauer.** (Königl. Materialprüfungsamt, Mitt. 24. 2. pp. 98–109, 1906.)—A study of the freezing-point curve and microstructure of the Cu-P alloys containing up to 15 per cent. P shows that phosphorus is only slightly soluble in solid Cu (up to about 0·175 per cent.), a well-defined eutectic, containing 8·27 per cent. P and solidifying at 707° C., being formed. A maximum in the freezing-point curve, and the end of the eutectic line at 14·1 per cent. P, correspond with the compound Cu_3P, but beyond this point the shape of the curve cannot be traced, as phosphorus is given off from such alloys at temperatures below the melting-point. The authors have also measured the electric potential of the alloys as against pure Cu in a normal solution of copper sulphate, as also the density and specific volumes, all of which show discontinuities at 14 per cent. P, thus further confirming the existence of the compound named above. The separation of P from alloys containing more than 15 per cent. P, at temperatures below their melting-point, led the authors to consider the form and interpretation of the temperature-concentration diagram which arises from such a case where a gaseous phase is present. For the discussion of this subject the reader must refer to the original paper and the diagrams accompanying it. The substances, rich in phosphorus, used by the authors were obtained by heating Cu filings with phosphorus at temperatures from 300° to 400° C., and the authors suggest a commercial method for producing such materials; when heated slowly these substances lose phosphorus in such a way that a definite composition corresponds to each temperature, that at 1,100° C. corresponding with the compound Cu_3P; if these bodies are heated rapidly the equilibrium with the vapour phase cannot be attained, and thus alloys richer in P than 14 per cent. can be obtained. W. Ros.

2120. *Nickel and Carbon Steels.* **E. Dixon.** (Engineering, 82. pp. 22–23, July 6, 1906.)—The results of tests of Ni steels, containing up to 5 per cent. Ni, both in the annealed and oil-tempered conditions, are given with comparison tests of carbon steels; these are sufficiently well known. The following figures were obtained with a steel containing Ni 5 per cent., Cr 0·6 per cent., and carbon 0·22 per cent.: Normalising gave a minimum hardness when carried out at 538° C., elastic limit, 46·3 tons per sq. in.; max. stress, 63·3 tons per sq. in.; elongation, 17 per cent. in 2 in. After heating to 760° C., the elastic limit was 75·1, max. stress 103·9 tons per sq. in., elongation 9 per cent. After very slow cooling from 635° the steel was in a good condition for machining, the elastic limit being 45 and the max. stress 54 tons per sq. in., and elongation 27 per cent. In impact tests of notched specimens the Ni-Cr steel was again superior to nickel steel. F. R.

2121. *Chemistry of the Acid Martin Furnace.* **Deslandes.** (Soc. d'Encouragement. Rev. de Métallurgie, Mém. 3. pp. 218–222, July 1, 1906.)—The following deductions are founded chiefly on 157 analyses of metal and the corresponding slags, and it is assumed that equilibrium of distribution of elements between metal and slag has been attained for the temperature of observation. With carbon from 0·15 to 0·50 per cent. in the metal, and SiO_2 from 45 to 56 per cent. in the slag, if $SiO_2 + 28{\cdot}25\ C > 59{\cdot}6$, there will be silicon in the metal; if $SiO_2 + 28{\cdot}25\ C < 59{\cdot}6$, the metal will be practically free from Si. This is irrespective of the saturation of the SiO_2 being due to FeO or MnO and of the presence of Ni or Cr. Between 0·20 and 0·55 per cent. carbon in the metal, and 58 to 59 per cent. SiO_2 in the slag, the ratio of percentage of Mn in the slag to percentage in metal $\lesseqgtr 100$, according as $SiO_2 + 44C \gtreqless 30{\cdot}8$. For other values of the ratio, curves are given showing the relation between the carbon and silicon contents of the metal. They are of hyperbolic form, with asymptotes parallel to the axes. Similar curves are obtained for the absolute manganese content of the metal, in function of the carbon and silicon contents. If $C > 0{\cdot}33 + 3{\cdot}4\ Si$, the Mn content depends only on Si and increases with it. If $C < 0{\cdot}12 + 0{\cdot}9\ Si$, the Mn content depends only on C and increases with it. The results verified the views that carbon is eliminated only after fusion and not below a certain minimum temperature, and that the ratio of sulphur in slag to that in metal diminishes when the basicity (particularly in Mn) increases. High temperature appears to favour elimination of sulphur. Ni is only found as traces in the slag, even when the metal contains as much as 25 per cent. Ni. F. R.

2122. *Segregation of Steel Ingots in Relation to Plate Specifications.* **C. L. Huston.** (Eng. News, 56. pp. 86–88, July 26, 1906. Extracts of paper read before the Amer. Soc. for Testing Materials, June 21, 1906.)—Photographs are given showing a longitudinal section of each of several plate ingots of various sizes; the line of blow-holes a short distance from each edge is well defined. Duplicate ingots were rolled into plate, and tests and carbon estimations made at numerous points throughout the plates. A variety of sizes of ingots show similar characteristics in the distribution, the series given ranging in size from 16 × 18 in. (2,800 lbs.) to 48 × 20 in. (11,000 lbs.). The ladle test of the heat from which the former was poured showed 0·18 per cent. carbon, but the contents in the plate varied from 0·18 at points on the outer surface to 0·27 at centre of top; the interior is fairly uniform at 0·20 to 0·23 per cent. The strength follows the carbon content. Other examples are detailed, including a 17,000-lb. ingot, rolled and cut into slabs and then rolled to plate. The importance of this variation of hardness in structural- and boiler-plates is indicated. F. R.

2123. *Velocity of Interaction of Carbon with Oxygen, Carbon Dioxide, and Steam.* **P. Farup.** (Zeitschr. Anorg. Chem. 50. 3. pp. 276–296, Aug. 31, 1906. Phys.-chem. Inst. d. Univ., Berlin, July, 1906.)—Carbon dioxide and steam act on carbon with the same velocity at 850° C., but this velocity is no greater than that in the case of oxygen at 450°. The velocity of the latter interaction increases in the ratio 1·5 : 1 for each 10° rise of temperature, and at 850° would probably be 3×10^6 times as great as that for the other two gases. The dissociation-constants would indicate, however, that the velocity in the case of pure oxygen should be only $0{\cdot}7 \times 10^6$ times as great, and it is therefore possible that the velocity of interaction varies with the concentration of the oxygen. T. M. L.

2124. *Free Energy of Halogen and Oxygen Compounds computed from Potential Measurements.* **M. de K. Thompson.** (Amer. Chem. Soc., Journ. 28. pp. 731–766, June, 1906. Amer. Electrochem. Soc., Trans. 9. pp. 337–352; Discussion, pp. 352–354, 1906.)—The author calculates the free energies of a number of halogen and oxygen compounds from the results of potential measurements published by various investigators. The methods of calculation are described in detail. In the case of the solid halides, the chloride has a free energy uniformly greater than that of the corresponding bromide by from 2,500 to 5,500 cals. per equivalent, and the bromide greater than the corresponding iodide by 7,000 to 11,000 cals. per equivalent. The corresponding halides of mercury (ous), silver and copper (ous) have free energies which differ from each other by less than 3,500 cals. per equivalent, but which increases slightly in every case in the order, Hg, Ag, Cu. The ratio of the free to the total energy of the solid salts examined, when these energies are referred to those of the elements in the solid state as zero, does not differ from unity by more than 7 per cent., except in the single instance of silver iodide. For approximate purposes, the usually well known heat of formation can hence be employed in the place of the often unknown free energy in the study of the equilibrium of reactions involving solid substances. For gaseous water and hydrogen chloride, produced from the gaseous elements, the ratio of free to total energy is not far from unity, but in the case of the other gaseous compounds it has widely divergent values. T. H. P.

2125. *Thermal Constants of Acetylene.* **W. G. Mixter.** (Amer. Journ. Sci. 22. pp. 13–18, July, 1906. Contribution from the Sheffield Chem. Lab. of Yale University.)—The author's results, obtained by means of a calorimetric bomb, are as follows: Heat of decomposition of acetylene at 20° C., 58,879 cals. per gm.-mol. From the measured heat of combustion at constant volume, the molecular heat of combustion at constant pressure at 0° C. is calculated to be 312,855 cals.; the value calculated from the heats of combustion of hydrogen and carbon, and the heat of decomposition of acetylene, being 311,775 cals. Since the explosions of acetylene under pressure, and of mixtures of this gas and oxygen are among the most violent chemical changes known, the author considers it possible that atomic disintegration and formation of radio-active gases occur, but no indications of this were observed. [See also Abstracts Nos. 131 (1902) and 1738 (1906).] T. H. P.

2126. *Law of Distribution in the Case in which one of the Phases possesses Mechanical Rigidity: Adsorption and Occlusion.* **M. W. Travers.** (Roy. Soc., Proc. Ser. A. 78. pp. 9–22, July 21, 1906.)—Measurements were made and complete curves plotted to show the relationship between the percentage weight of CO_2 absorbed by carbon and the pressure of the gas at 100°, 61°, 35°, 0°, and −78°, and also for hydrogen at −190°. The relationship is similar to that which has already been found for the absorption of gases by Pd and by Pt. It may be expressed by the formula $p^{1/n}x^{-1} =$ constant, the value of n increasing as the temperature falls, thus at 0° $n = 3$, and at 100° $n = 2$ approximately. It is probable that at higher temperatures n would fall to unity, and that CO_2 would thus obey the ordinary law of distribution. Hydrogen at −190° behaves like CO_2 at 0°. It is pointed out that a similar formula holds for the absorption of iodine from solution by animal charcoal ($n = 4$), and also for the absorption of dyes by textile materials. It is suggested that equilibrium is determined by diffusion into the rigid absorbent, the interior of which takes up much less than the exterior when the transference of solute ceases. This view appears to postulate that, under the conditions obtaining in these experiments, diffusion only takes place when the concentration-gradient exceeds a definite minimum value. T. M. L.

2127. *Chemical Kinetics in Concentrated Sulphuric Acid. Decomposition of Oxalic Acid.* **G. Bredig** and **D. M. Lichty.** (Zeitschr. Elektrochem. 12. pp. 459–468, July 6, 1906.)—Oxalic acid is completely decomposed into $CO_2 + CO + H_2O$ by sulphuric acid, whose percentage ranges between 100 and 50, but the velocity of the reaction is to an extraordinary degree influenced by the concentration of the acid. Kohlrausch and Knietsch had already observed that the electric conductivity and freezing-point depression of the 100 per cent. acid are very sensitive to very small percentages of water. This reaction velocity, as determined by titration with permanganate, is still more sensitive. Presence of 0·1 per cent. of water changed the period of reaction from one hour into seventeen hours. Curves are given for water percentages, growing by increments of 0·01 per cent. Addition of sulphates to the concentrated acid also has a retarding influence, about one-tenth as large as that of water. An excess of SO_3 in the H_2SO_4, on the other hand, hastens the reaction remarkably. The minimum of electric conductivity does not coincide with a maximum or minimum of chemical activity. H. B.

2128. *Volatility of Alkyl Derivatives of Water.* **L. Henry.** (Annal. Soc. Sci. de Bruxelles, 29. pp. 209–214, 1904–1905.)—With most hydrides, the replacement of hydrogen by alkyl radicals results in a rise of the boiling-point, whilst in the case of water the same substitution causes a lowering of the boiling-point. The author explains this as due to the molecular condition of water, which, having regard to the physical state of hydrogen and oxygen, should be gaseous and not liquid. Thus the replacement of the hydrogen of gaseous hydrides by alkyl radicals does not modify their monomolecular condition, whilst the coefficient of association is continuously lowered as the replacement of the hydrogen is carried further and further. T. H. P.

2129. *Ultramicroscopic Observations. Characterisation of Inorganic Colloids.* II. **W. Biltz** [with **W. Geibel**]. (Gesell. Wiss. Göttingen, Nachr., Math.-phys. Klasse, 2. pp. 141–156, 1906. Communication from the chem. Laborat. d. Bergakademie, Clausthal.)—Colloidal solutions of the following inorganic substances have been examined ultramicroscopically by the authors, viz., aluminium oxide, chromium oxide, zirconium oxide, silicic acid, ferric oxide, vanadium pentoxide, tungsten blue, molybdenum blue, Berlin blue. It is found that they consist essentially of amicrons, *i.e.*, of particles too small to be detected even by the ultramicroscope. In the case of gold, antimony sulphide, and arsenic sulphide, hydrosols containing particles of various dimensions can be obtained according to the dilution; as the dilution increases the number of amicrons increases, so that it would seem as if it might be possible to pass continuously from a suspension to a solution in which the particles are of molecular size. Solutions of cerium oxide containing glycerol have also been studied. [See Abstract No. 3317 (1904).] A. F.

2130. *New Method for Measurement of Hydrolysis of Aqueous Solutions.* **R. B. Denison** and **B. D. Steele.** (Chem. Soc., Journ. 89. pp. 999–1018, June, 1906.) —In the determination of ionic velocities by the authors' method [see Abstract No. 802 (1906)] it is essential that the auxiliary or indicator solution should undergo no hydrolysis, any new ions produced having an effect upon the apparent velocity of the ion under observation. It is now shown that when a salt in which hydrolysis is used as indicator is employed, the difference between the real and apparent velocities of the ion is dependent on the degree of hydrolysis, and from a study of the motion of the different ions in the system, a formula has been deduced which enables the degree of hydrolysis in the indicator solution to be readily calculated from the results of three conductivity measurements. The "hydrolysis constants" of the hydrochlorides of aniline and *o*- and *p*-toluidine obtained in this way agree closely with those found by Bredig, and the method can be extended to determine the concentration of given ions in complex mixtures. W. H. St.

2131. *Method for determining Velocities of Saponification.* **J. Walker.** (Roy. Soc., Proc. Ser. A. 78. pp. 157–160, Aug. 18, 1906. From the Chem. Lab., Univ. College, Dundee.)—The author describes a method for following the progress of a reaction by measurement of the electrical conductivity. The method was applied to the case of saponification of an ester by caustic soda. Since the conductivity of the sodium hydroxide is much greater than that of the sodium salt produced by the saponification, owing to the high velocity of the hydroxyl ion compared with the salt anion, and since sodium hydroxide and sodium salts of monobasic acids are approximately equally ionised under the same conditions, the ionisation in dilute solution remains practically the same throughout the saponification, and thus the change in conductivity is almost exactly proportional to the progress of the reaction. The velocity of saponification of methyl and ethyl acetates was investigated by this method, and the constant found agreed with that found by titration methods. F. J. B.

2132. *Molecular Constitution of Aqueous Solutions.* **W. Sutherland.** (Phil. Mag. 12. pp. 1–20, July, 1906.)—The contraction occurring when electrolytes dissolve in water is due to their changing some of the trihydrol of the water into dihydrol. For positive ions this change is positive, and for negative ions negative, *i.e.*, negative ions tend to polymerise the solvent. If λ is ionic velocity, K dielectric capacity of the stuff of an atom, B the limiting volume of the gramme atom, and τ the gramme molecules of $(H_2O)_3$ changed into $(H_2O)_2$, then $\tau(\lambda KB^{\frac{1}{3}})^{-\frac{1}{4}}$ is constant for positive ions and $\tau(\lambda KB^{\frac{1}{3}})^{-\frac{1}{3}}$ for negative ions. From a consideration of the special properties of the H- and OH-ions, it is deduced that the exceptional ionic velocities assigned to these ions do not represent the true velocities; it is suggested that the velocities hitherto assigned are 2·92 times the true velocity of H and 1·92 times the true velocity of OH. T. M. L.

2133. *Vapour Density Determinations by the Victor Meyer-Nernst Method.* **L. Löwenstein.** (Zeitschr. Phys. Chem. 54. pp. 707–714, March 13, 1906. From Dissertation, Göttingen, 1905.)—The author uses a modification of Victor Meyer's vapour density apparatus similar to that devised by Nernst [see Abstract No. 2390 (1904)], excepting that the bulb, the heating tube, and the vessel for holding the substance are of platinum. The small vessel rests on a piece of iron surrounded by an electromagnet, and drops when the current is passed momentarily. At 1,350° the vapour density of CO_2 is 43·8, and that of mercury 203–212, the latter numbers being a little too high on account of condensation. CO_2 is found to be dissociated to the extent of 0·4 per cent. at 1,550°. T. H. P.

2134. *Osmotic Pressure and Freezing-point Depression of Dextrose Solutions.* **H. N. Morse, J. C. W. Frazer, and B. S. Hopkins.** (Amer. Chem. Journ. 36. pp. 1–39, July, 1906.)—The measurement of osmotic pressure is complicated by certain thermometer effects or temporary fluctuations of pressure which follow changes of temperature and are due to the expansion or contraction of the liquids in the cell, and not to actual variations in osmotic pressure. These effects are the principal factors in preventing the attainment of any considerable accuracy in the measurement of osmotic pressures. For obviating them, the authors have designed a complicated apparatus, which is described in detail. The results of a number of observations on membranes are given, for which the original must be consulted. [Compare Abstract No. 423 (1906).] T. H. P.

2135. *Osmotic Pressures and Freezing-point Depressions of Cane-sugar Solutions.* **H. N. Morse, J. C. W. Frazer, E. J. Hoffman, and W. L. Kennon.** (Amer. Chem. Journ. 36. pp. 39–93, July, 1906.)—Further measurements confirm the conclusion of Morse and Frazer [Abstract No. 423 (1906)] that cane-sugar in aqueous solution exerts an osmotic pressure equal to that which it would exert if it were gasified at the same temperature and the volume of the gas reduced to that of the solvent in the pure state. At present it remains undecided whether the standard for the volume of the solvent in the pure state is its volume at max. density or that at the prevailing temperature. The apparent abnormality of the freezing-point depressions of cane-sugar solutions disappears if the density factor is considered, and it is found that, for all concentrations, $\Delta_1 = 1{\cdot}85\mathrm{ND} = \Delta$, where Δ_1 and Δ are respectively the calculated and observed depressions, D the density of the solution at its freezing-point, and N the concentration expressed in terms of the normal. T. H. P.

2136. *Dissociation of Nitric Acid in Mixtures of Water and Ether.* **P. Bogdan.** (Annal. Scientifiques de l'Univ. de Jassy, 4. pp. 108–118, June, 1906. Zeitschr. Elektrochem. 12. pp. 489–498, July 20, 1906.)—Ostwald's dilution law only holds for dilute solutions of nitric acid in a mixture of water and ether, being exact when λ/λ_∞ is the measure of the degree of dissociation. The addition of ether to water containing nitric acid causes a very slight increase in the degree of dissociation. As the conductivity of solutions of nitric acid saturated with ether is much inferior to the conductivity in pure water, it can be concluded that the ether effects a considerable diminution in the mobilities of the ions of this acid; this explains why the conductivity of dilute ethereal solutions of nitric acid is almost zero, although the acid present is appreciably dissociated. [See also Abstract No. 480 (1906).] T. H. P

2137. *Mechanism of Ionisation by Solution.* **G. D. Hinrichs.** (Comptes Rendus, 143. pp. 549–550, Oct. 15, 1906. Extract.)—Fluids are regarded as made up of particles revolving about an axis, such that the moment of inertia is a minimum. Dissolution is the grinding up of a solid by the rotating particles, which, therefore, move more slowly and assume a lower temperature. Water being an insulator, the grinding gives rise to statical electricity, and the positive and negative charges become attached to the metal and non-metal of the dissolved salt, causing ionisation. In a dilute solution the ions are insulated and do not recombine; in stronger solutions the insulation is less perfect, and recombination occurs; ionisation is therefore only complete at great dilution. The author considers that he has thus placed Arrhenius' hypothesis on a firm foundation as a necessary deduction from molecular mechanics. T. M. L.

2138. *Lecture Experiments to Illustrate the Theory of Ionisation.* **W. W. Taylor.** (Roy. Soc. Edinburgh, Proc. 26. pp. 325–326, 1905–1906.)—To show that ionisation of an acid is decreased by addition of a salt of the acid, a solution of egg-albumen is added to a solution of nitric acid which is so dilute that no coagulation occurs; on adding a saturated solution of potassium nitrate coagulation immediately takes place owing to the production of un-ionised nitric acid, which alone of the substances present is able to produce coagulation. To show that a weak acid is able partially to displace a strong acid from its salts, acetic acid is added to a mixture of egg-albumen with saturated potassium nitrate, and causes coagulation, though neither acetic acid, potassium nitrate, nor potassium acetate, will do this.

T. M. L.

2139. *Influence of Pressure and of Form of Discharge on Ozone Production.* **A. Chassy.** (Comptes Rendus, 143. pp. 220–222, July 23, 1906.)—In a Berthelot ozoniser, the electric potential influences the velocity of formation, but not the maximum yield of ozone. The smaller the pressure the greater is the initial velocity of formation of ozone. At 15°, the amount of ozone formed under 10 cm. pressure is about 1/15 of that obtained under 76 cm. pressure. At pressures below 6 cm. no ozone is formed. If, however, ozonised oxygen is rarefied until its pressure is less than 6 cm., the ozone does not decompose, although this will take place if it is then subjected to the influence of the discharge. It may be assumed that formation of ozone ceases when the velocity of the ions formed by the discharge is too great.

T. H. P.

2140. *Polarisation Capacity of Iron, and Passivity.* **C. McC. Gordon** and **F. E. Clark.** (Zeitschr. Elektrochem. 12. pp. 769–772, Oct. 19, 1906. Translation. Amer. Chem. Soc., Journ. 28. pp. 1534–1541, Nov., 1906. Abstract.)—Iron wires of 99·6 per cent. Fe, 0·8 mm. in diam., are dipped into acid, salts, and caustic soda, and the polarisation capacity is determined by comparison, in a Wheatstone bridge with the aid of a telephone as zero instrument, with a metallic condenser (Nernst and Gordon). The measured capacity may be a real electrostatic capacity due to a film of great resistance on the electrode, or an apparent capacity, caused by changes in the electrode potential due to changes in the electrode or in the concentration of the electrolyte. In most cases the polarisation can be compensated by a condenser with resistance in parallel, but not in diluted nitric acid (the size of the electrode is of importance in this case), nor, after kathodic polarisation, in $FeSO_4$ and $FeCl_3$. The capacities agree with Finkelstein's. But while Finkelstein, relying chiefly on potential measurements, will not ascribe the passive state to the formation of an oxide film, the authors accept this film in accordance with Haber and Goldschmidt [see Abstract No. 631 (1906)]. The film may contain pores which would open out with higher current densities, and thus explain the resulting better conductivity. The authors would assume oxide films for Au and Pt.

H. B.

2141. *Chemical Effect of Radiation of Short Wave-length on Gaseous Bodies.* **E. Regener.** (Ann. d. Physik, 20. 5. pp. 1033–1046, Sept. 14, 1906. Inaug. Dissertation, Berlin, 1905. Écl. Électr. 49. pp. 395–397, Dec. 8, 1906.) —1. The deozonising action of short-wave-length ultra-violet radiation is proved, and the equilibrium condition of this action with the already known ozonising action is determined. 2. The determination of the approximate wave-length of the deozonising rays was made by absorption researches; waves under 200 $\mu\mu$ act as ozone formers, those about 257 $\mu\mu$ as disturbers of ozone formation. 3. The connection of the same action with temperature and spontaneous deozonisation was determined. 4. It was proved that short-wave-length ultra-violet radiation decomposes ammonia, and the oxides of nitrogen NO and N_2O. The action of the silent discharge is very various. If there is a real connection between the action of the silent discharge and that of the ultra-violet rays, the knowledge of photo-chemical phenomena may obtain a considerable extension. In many investigations the ultra-violet rays must be absorbed by the gases, and it may be important to enclose such gases in vessels made of a material (such as fluorspar) which transmits freely the rays of short wave-length.

J. J. S.

2142. *Disintegration of Carbon Kathodes in the Electrolysis of Fused Sodium Chloride.* **G. I. Kemmerer.** (Amer. Electrochem. Soc., Trans. 9. pp. 117–119;

Discussion, pp. 119–120, 1906.)—Carbon kathodes, dipping 1½ in. into fused salt, were completely disintegrated within 2 min. by currents of 27 amps. at 25 volts, and lost 6·785 gm. in weight, against a loss of 0·184 gm. sustained by graphitic kathodes. If not very carefully washed after the experiment, the kathodes would show an apparent gain in weight, owing to the absorption of salt. The disintegration was not proportional to Faraday's law, and might be due to the formation of a sodium carbide. In the *discussion*, **Forssell** suggested that the hydrocarbons of ordinary carbon, and the binders used in cementing carbon flour, sulphur, and other impurities, might be of greater influence than the sodium alloys, carbide, and porosity to which **Bancroft, Burgess,** and **Rodman** referred. H. B.

2143. *Grey-Platinised Anodes for Alkali Chloride Electrolysis.* **W. Geibel.** (Zeitschr. Elektrochem. 12. pp. 817–819, Nov. 9, 1906. From the laboratory of W. C. Heraeus, Hanau.)—When the anodes of bright Pt are replaced by platinised anodes, the pressure is reduced by 0·5 volt and the yield of chlorate increased. The black Pt films of Lummer and Kurlbaum do not adhere well, however, and Foerster and Müller found [see Abstract No. 526 (1903)] that anodes platinised grey by heating the black film electrodes gave higher pressures. By baking the black electrodes in electric slab furnaces at the lowest possible temperatures, Heraeus obtains durable electrodes in various shades between black and grey. Arranging in series three electrolytic alkali chloride cells, provided respectively with black, grey, and bright Pt anodes, the author observed pressures of 2·88, 2·97, and 3·45 volts after 5 hours. The yield of chlorate was in all the cells fairly the same, when the electrolyte which contained potassium chromate was neutral. When the electrolyte was acidified with hydrochloric acid, the black and grey anodes gave the same yields, which were by 5 per cent. higher than those with the bright Pt anodes, although an oxygen evolution was observed with the grey anodes. H. B.

2144. *Electro-deposition of Iron from Aqueous Ferrous Chloride and Sulphate Solutions.* **A. Ryss** and **A. Bogomolny.** (Zeitschr. Elektrochem. 12. pp. 697–703, Sept. 14, 1906. Communication from the Inst. f. phys. Chemie und Elektrochemie d. techn. Hochschule, Karlsruhe.)—The maximum current densities for obtaining good deposits of iron are 0·4 amp. per sq. cm. for ferrous chloride solutions, and 0·5 for ferrous sulphate, but at first the values should be kept lower than these. With the sulphate, the best conditions are: room temperature and 70 gm. of crystallised salt per litre; with the chloride, a temperature of 60–70° and 1 kg. of the salt per litre of water. Even under these conditions it is not possible to obtain a compact deposit more than 0·3 mm. in thickness, and this was not increased by adding various electrolytes and non-electrolytes. [Compare Maximowitsch, Abstract No. 898 (1905).] T. H. P.

2145. *Silver Perchlorate as Electrolyte in a Silver Coulombmeter.* **H. S. Carhart, H. H. Willard** and **W. D. Henderson.** (Phys. Rev. 23. pp. 189–191, Aug., 1906. Abstract of paper read before the Amer. Physical Soc., June 29–July 3, 1906. Amer. Electrochem. Soc., Trans. 9. pp. 375–380, 1906.)—When a solution of carefully purified silver perchlorate is electrolysed, the silver deposited adheres better than that obtained when silver nitrate is employed. With the former salt, the deposit is slightly heavier than with the nitrate. T. H. P.

2146. *Gas-Voltameter with Nickel Electrodes. Formation of Nickel Peroxide.* **H. Riesenfeld.** (Zeitschr. Elektrochem. 12. pp. 621–623, Aug. 17, 1906. From the Phys.-chem. Abt. des Breslauer Universitätslaborat.)—A gas-voltameter, in which sodium or potassium hydroxide was electrolysed in series with a copper and a silver voltameter, gave a normal result when Pt electrodes were used, but with Ni electrodes there was a deficiency which amounted to as much as 15 per cent. when a low current density was used. The effect increases with the area of the Ni electrodes, and could be explained as due to the catalytic action of the metal on the hydrogen and oxygen dissolved in the electrolyte; thus after low values had been obtained it was always found that there was a reduced pressure in the voltameter from which the gas had been delivered. On the other hand, the voltameters with Ni electrodes sometimes gave values from 8 to 15 per cent. higher than the normal figures. It was noticed that after the voltameter had been used for some time, a brown deposit formed on the anode, but redissolved if the current was reversed or interrupted; this deposit could also be produced on a fresh electrode when a higher current density was used, but was difficult to form on nickel-plated Ni electrodes, which gave a normal liberation of gas. The deposit was found to be nickel peroxide, and Ni could be detected in the solutions in which it formed. It is suggested that in addition to the catalytic action of the Ni, the metal is also, to some extent, dissolved in the alkali and deposited in the form of peroxide. The changes which take place are compared with those occurring in the forming of an accumulator plate. T. M. L.

2147. *Silver Titration Voltameter.* **W. Kistiakowsky.** (Zeitschr. Elektrochem. 12. pp. 713–715, Sept. 21, 1906. Phys.-chem. Laborat. des Polytechnikums, St. Petersburg, Aug. 14, 1906.)—The author describes a new form of silver titration voltameter (compare Zeitschr. Phys. Chem. 6. p. 105, 1890), which is easy to charge and has a constant and relatively small internal resistance. It is recommended in all cases where a number of estimations of currents flowing for short periods of time (an hour at the most) are to be carried out, and the current should not exceed 0·2 amp. The error may amount to ± 0·1 per cent. T. H. P.

REFERENCES.

2148. *Distillation of Metals in the Electric Furnace.* **H. Moissan.** (Annal. Chim. Phys. 8. pp. 145–181, June, 1906.)—The full paper containing the results of the work mentioned in Abstracts Nos. 401, 598, 787, 963 (1906).

2149. *The Electric Furnace.* Part III. **A. Minet.** (Faraday Soc., Trans. 2. pp. 1–28; Discussion, pp. 29–31, Aug., 1906.)—[For first two Parts see Abstract No. 1668 (1905).] This Part deals with industrial furnaces.

2150. *Conductivity of Concentrated Aqueous Electrolytes.* **J. Gibson.** (Roy. Soc. Edinburgh, Proc. 26. pp. 234–237, 1905–1906.)—The author suggests that the equivalent conductivities of aqueous electrolytes should refer to solutions containing equivalent quantities of solute per 1,000 gm. of solute rather than per 1,000 c.cm. of solution. This method, which has already been used by several other investigators, leads to simpler relationships between conductivity and concentration, including an approximately linear relation between the mass-equivalent conductivity $\Delta\mu$, and the mass-concentration γ. T. M. L.

2151. *Solubility of Metal Ions with Electromotive Equilibrium.* **A. Smits.** (Konink. Akad. Wetensch. Amsterdam, Versl. 14. pp. 859–866, May 9, 1906. Proc. 9. pp. 2–9, June 21, 1906.)—A theoretical paper in which the equilibrium between a metal and a solution of one of its salts is discussed from the standpoint of the electrical charges produced when the two are brought into contact. T. M. L.

2152. *Heat Treatment of 0·5 to 0·8 per cent. Carbon Steels.* **C. E. Corson.** (Amer. Inst. Mining Engineers, Bull. 11. pp. 725–742, Sept., 1906.)—The author's study of the microstructure and tensile strength of a series of steels leads him to support current views as to the effects of hot and cold work and various rates of cooling upon steels in this range of composition. F. R.

2153. *Heat Treatment of some High Carbon Steels.* **W. Campbell.** (Amer. Chem. Soc., Journ. 28. pp. 1304–1322, Oct., 1906. Metallurgie, 3. pp. 741–747, Nov. 22, and pp. 781–786, Dec. 8, 1906.)—A detailed account of the experiments referred to in Abstract No. 1637 (1906) with curves and photomicrographs. F. R.

2154. *Formation of Endothermic Compounds at High Temperatures.* **Berthelot.** (Comptes Rendus, 142. pp. 1451–1458, June 25, 1906. Annal. Chim. Phys. 9. pp. 163–173, Oct., 1906.)—The conclusion recently arrived at, that endothermic compounds, which are obtainable only indirectly at the ordinary temperature, are formed directly at high temperatures, is based on the validity of thermodynamic formulæ at temperatures far higher than those at which they have been confirmed experimentally. The author discusses the question. T. H. P.

2155. *Evolution of the Elements.* **F. Soddy.** (Chem. News, 94. pp. 85–89, Aug. 24, 1906. Paper read before the British Assoc. at York.)—An interesting summary of the facts relating to the hypothesis of the transmutation of the elements, and of the theory worked out by Rutherford based on the experiments of himself and others on radio-activity. The paper was the introduction to a discussion on radio-active change at the York meeting of the British Association. J. J. S.

2156. *Atomic Weight of Copper.* **E. Murmann.** (Akad. Wiss. Wien, Sitz. Ber. 115. 2b. pp. 177–187, March and April, 1906.)—The mean of the author's results for the atomic weight of copper, obtained by the reduction of copper oxide and the oxidation of copper, is 63·53 ± 0·03. T. H. P.

2157. *Sublimation of Platinum below its Melting-point.* **A. Guntz** and **H. Bassett, Jr.** (Bull. Soc. Chim. 33. pp. 1306–1308, 1905.)—A crystalline deposit of pure platinum has been noticed by the authors to be slowly formed on the magnesia *brasque* of electric furnaces near the platinum electrodes. L. H. W.

2158. *Bessemerisation of Foundry Residues.* **P. Schwietzke.** (Metallurgie, 3. pp. 695–697, Oct. 22, 1906. Communication from the Aachener Inst. für Metallhüttenw. u. Elektrometallurgie.)—By bessemerising foundry refuse containing copper, tin, lead, and zinc, or their oxides, the lead and zinc are oxidised first, more especially when the temperature is raised by enriching the blast with oxygen, a practically pure copper-tin alloy resulting. Experimental details are given. W. Ros.

2159. *Alloys of Sodium with Lead, Cadmium, Bismuth, and Antimony.* **C. H. Mathewson.** (Zeitschr. Anorg. Chem. 50. 2. pp. 171–198, July 30, 1906. Metallog. Communication from the Inst. f. anorg. Chemie d. Univ., Göttingen.)—Complete thermal analyses, with the temperature-concentration diagrams resulting from the observations, are given for all the alloys, and the results compared with those of previous authors. W. Ros.

2160. *Copper and Iron Sulphides.* **P. Röntgen.** (Metallurgie, 3. pp. 479–487, July 22, 1906. Communication from the Inst. f. Metallhüttenw. u. Elektrometall. d. kgl. techn. Hochschule, Aachen. Electrochem. Ind., N.Y. 4. pp. 366–367, Sept., 1906.)—A temperature-concentration diagram for the system Cu_2S, FeS is worked out and microscopic sections of some of the reguli are given. The authors apply their results to considerations of the nature and origin of certain copper ores. W. Ros.

2161. *Mixtures of Antimony with Tellurium and Selenium. Cryoscopic Constant of Antimony.* **H. Pélabon.** (Comptes Rendus, 142. pp. 207–210, Jan. 22, 1906.) T. H. P.

2162. *Fusibility of Mixtures of Tin with Sulphur, Selenium, or Tellurium.* **H. Pélabon.** (Comptes Rendus, 142. pp. 1147–1149, May 21, 1906.) W. H. Si.

2163. *Sulphide, Selenide, and Telluride of Silver.* **H. Pélabon.** (Comptes Rendus, 143. pp. 294–296, July 30, 1906.) T. H. P.

2164. *Hydrates of Sodium Thiosulphate.* **S. W. Young** and **W. E. Burke.** (Amer. Chem. Soc., Journ. 28. pp. 315–347, March, 1906.)—Thirteen crystalline modifications of sodium thiosulphate are described. The solubilities of the various forms are given between 0° and 80°, and also the transition-points of the system. T. H. P.

2165. *Dissolution of Metals.* III. **T. Ericson-Aurén** and **W. Palmaer.** (Zeitschr. Phys. Chem. 56. pp. 689–702, Sept. 28, 1906.)—A reply to the criticisms of Brunner [Abstract No. 1111 (1905)]. T. M. L.

2166. *General Equations of the Theory of Solutions.* **J. E. Trevor.** (Journ. Phys. Chem. 10. pp. 392–412, May, 1906.) T. M. L.

2167. *Function ψ in Neighbourhood of Plait-point.* **J. E. Verschaffelt.** Konink. Akad. Wetensch. Amsterdam, Versl. 14. p. 695, Feb. 7, 1906. Proc. 8. pp. 752–753, April 24, 1906.)—A correction to Abstract No. 449 (1903). It appears that a complex function of *x* has been neglected which effects higher approximations than the first. H. H. F. H.

2168. *Formation of Hydrogen Peroxide by Means of the Tesla Discharge.* **A. Findlay.** (Zeitschr. Elektrochem. 12. p. 129, Feb. 23, 1906.)—Referring to Nernst's paper (ibid. 11. p. 710, 1905) the author points out that he has obtained H_2O_2 by the action of the Tesla discharge on a mixture of steam and oxygen, and believes that other combinations were also effected by the same discharge. L. H. W.

2169. *Law of the Independent Migration of the Ions.* **W. Palmaer.** (Zeitschr. Elektrochem. 12. pp. 509–511, July 27, 1906.)—A new proof is given of Kohlrausch's law. T. H. P.

2170. *Theory of E.M.F. in Systems containing a Non-aqueous Phase, or Several Phases.* **E. Abel.** (Zeitschr. Phys. Chem. 56. pp. 612–623, Sept. 7, 1906.)—Formulæ are given for the e.m.f. of concentration cells in which a metal is in contact with solutions of its salts in two different solvents. T. M. L.

2171. *Potential Differences between Manganese and Lead Peroxides and Various Aqueous and Non-aqueous Solutions.* **L. Kahlenberg** and **A. S. McDaniel.** (Amer. Electrochem. Soc., Trans. 9. pp. 365–373; Discussion, pp. 373–374, 1906.)—The authors have measured the electrode potentials between electrodes of PbO_2 and MnO_2 and solutions of lithium chloride and also sulphuric acid in pyridine, acetone, amylamine to which varying amounts of water have been added. The potentials with PbO_2 electrodes are greater than with MnO_2. A. F.